ELECTRICAL ENERGY SAVING APPROACHES ADOPTED IN GENERAL HOSPITALS IN KOGI STATE, NIGERIA

BY

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MTech/SSTE/2018/8657

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A THESIS SUBMITTED TO POSTGRADUATE SCHOOL, FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGERIA, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF DEGREE OF MASTER OF TECHNOLOGY IN INDUSTRIAL AND TECNOLOGY EDUCATION

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ABSTRACT

This study examined the electrical energy saving approaches adopted in general hospitals in Kogi State, Nigeria. The study sought out the electrical energy efficiency appliances and devices used, the maintenance practices adopted for efficient electrical energy saving, the attitudes of staff towards electrical energy savings, electrical energy appliances and devices refurbished and staff motivations towards electrical energy savings in general hospitals in Kogi State. Five research questions and five null hypotheses guided the study. The study adopted a descriptive survey research design. The targeted population for the study was 672 respondents. Through multi staged sampling techniques, 26 Doctors, 135 Nurses, 20 Nurse Aides, 9 Electrical Technicians and 11 Laundry staff were sampled. A structured questionnaire was used for data collection. The instrument was validated by three experts, two from the Department of Industrial and Technology Education, and one from the Department of Electrical and Electronic Engineering, Federal University of Technology, Minna. Cronbach Alpha was used to ascertain the extent of the internal consistency of the instrument and a reliability coefficient was given for clusters A: 0.85, B: 0.76, C: 0.78, D: 0.81 and E: 0.80 respectively. An overall reliability coefficient of 0.80 was obtained for the entire instrument which was very high and therefore considered acceptable for the study. Data collected was analyzed using Statistical Package for Social Science (SPSS version 23). Mean and Standard Deviation was used to answer the research questions, while ANOVA was used to test the hypotheses at 0.05 level of significance. The findings clearly revealed that the mean of 2.26 was obtained which indicated that they rarely use efficient electrical energy appliances and devices; mean of 1.88 were obtained which as well indicated that they rarely adopt maintenance practices for efficient electrical energy saving; mean of 2.96 was obtained which indicated that staff agreed to proper attitudes towards electrical energy savings; and mean of 1.47 was obtained which indicated that they strongly disagreed with the ways staff are motivated towards electrical energy savings. It is recommended that the hospital management board should ensure the installation of electrical energy saving appliances and devices in the hospital, The attitude of staff should be improved towards electrical energy savings through training, seminar and workshop on the importance of energy savings in an organization,The attitude of staff should be improved through promotional energy savings activities such as wall stickers, labels charts and illustration to constantly remind staff and other users of electrical energy about electrical energy savings. Staff can be motivated towards electrical energy savings through provision of special allowance to the best electrical energy saving staff. Free sponsored trips and other incentives should also be used to motivate staff.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

Hospitals are institutions for the care of the sick and injured and usually function 24 hours per day, all year round. Adenuga (2012), defined hospital as an institution for healthcare that provides patient with treatment by specialized staff and equipment. Hospitals are largely staffed by professionals like physicians, surgeons, and nurses. It is therefore a place where patients visit for medical checkup or treatment. Hospital in the context of this study is a government owned hospital (General Hospital) that provides treatments for patients in a cheaper and more affordable rate.

The general hospitals usually consist of large buildings, and careful control of their internal climate is considered necessary. Substantial amount of heat is normally generated internally by the occupants and operating equipment. An effective cooling (and heating depending upon the external weather conditions) and ventilation systems combined with good insulation of hospital building, usually reduce hospital’s sensitivity to the outside weather which make electrical energy indispensable in the healthcare facilities. These facilities include physician’s offices, dentist’s offices, patient centers, medical laboratories, home healthcare facilities, general medical and surgical hospitals, and community care facilities. Hospitals thereby require efficient electricity to ensure a continuous supply of power in emergencies and critical operations.

Electricity is a form of energy mostly used for heating, lighting and powering of machines and several electrical appliances. Alumona *et al.*, (2014) explained electrical energy as the most important form of the energy that drives the economy of any society or country and makes the common citizen happy. Electrical energy in the content of this study is the electricity available in the general hospital to save lives and carries out day to day activities with equipment and facilities. According to (Beamon & Messer, 2018) Electrical energy consuming equipment in hospitals are classified as; Medical Technical Equipment (MTE) Building Equipment (BE), Information, Computer, Telecom (ICT) equipment.

This equipment and other services according to Gordo (2017), depends largely on a reliable power supply for preservation of a wide variety of drugs, blood and other tissue samples (human organs) in refrigerators, sterilization of surgical devices, water purification, lighting and thermal comfort for patients and staff, to mention but a few, depend entirely on regular electricity supply, such that disruptions in power supply, generally, affect treatment schedules.

The electricity supply poorly managed by the general hospital staff might be due to huge amount of daily mismanagement of power supply and ignorance on the effective use of electrical power supply. Mkalaf (2018), most equipment used in the hospital such as surgical devices, refrigerators, lighting system, Air conditioners and a few more are rarely put off while not in use which leads to energy wastage. Equipment and machines not in use should thereby be put off for the purpose of electrical energy savings.

Electrical energy savings is the effort made to reduce the consumption rate of electrical energy by effectively using the electrical power supplied. Khan and Halder, (2016) explained electrical energy saving as proper way of using electricity by which the cost and time of consumption of power supplied will be saved and the utilization will be optimum. Electrical energy saving in the context of this study is the proper ways at which general hospital manage the electricity usage in the hospitals. This can be achieved either by using energy more efficiently or by reducing the amount of services used by electrical energy appliances.

Electrical energy efficiency appliances and devices are energy star equipment that can significantly reduce electricity consumption. Electrical energy efficiency measures can help insulate hospital against rising electricity tariff and save electrical energy. Diesendorf (2019) explained energy efficiency goal as to reduce the amount of energy required to provide services and products. For example insulating a home allows a building to use less heating and cooling energy to achieve and maintain a comfortable temperature. Electrical energy efficiency appliances and devices in the context of this study are those electrical appliances and devices used in hospital for treating and rendering services to the patients and staff. The appliances and devices could be dry heat sterilizer, lighting thermal control, surgical lights, rechargeable DC fan, KUB X-ray machine, continuous-flow anaesthetic machine, light dimmers amongst others, are used in the hospital by the hospital staff and patients. For effective utilization of electrical energy efficiency appliances and devices it requires proper maintenance.

Maintenance is a means of keeping machine and devices on proper check to avoid malfunctioning. In a deeper view, it is defined as the combination of all technical and administrative procedures planned to restore an item to its good state, it should be taken into consideration in any risk management plan (Jandali *et al.*, 2017). Maintenance practices in the context of this study is the process by which staff of the hospital maintains appliances and devices used in the general hospital. Mkalaf (2018), explained that most government equipment are not properly maintained and handled by the staff and personnel working with it, this is as well due to poor supervision, which is applicable to hospital staff’s attitudes.

Attitude is the way of carrying oneself or the way one tends to behave. World Health Organization (2010) explained that energy consumption of hospital building is reported to be among the highest compared to commercial and residential buildings due to its 24hours operation and intensive electrical energy use of medical equipment, appliances and devices. Hospital staff thereby finds it difficult to put off appliances and devices not in use and as well reduce the work load of most machines. Many staff do not know the effect of leaving machines, appliances and devices on while not in use, however do not find fault in doing this. Staff as well focuses on how to carry out their task with the electrical equipment rather than manage the electricity it consumes. Attitude and behavior of hospital staff towards use of electricity in hospital contribute to the excessive usage of power supply in the hospital. For a proper management of electrical energy, hospital staff should change their attitudes towards electrical energy usage and savings. Eusoff and Ismail (2015) on occupant's behaviour in reducing the standby mode of medical equipment's waste management, revealed the establishments of energy benchmarks for hospital buildings, analyzed the breakdown of energy use in hospital buildings adopted energy efficient technologies such as occupancy sensors, LED lights and adoption of a better energy monitoring system. Although these various technical initiatives have shown successful cases in reducing the electrical energy used in a hospital building, additional way of reducing electrical energy usage is by refurbishing.

Refurbishing is the process of cleaning, decorating, renovating and providing equipment, devices and structures with new facilities or equipment. Refurbishment progress have been provoked by the increase in complexity in manufacturing processes and variety of products, growing awareness of the impact of refurbishment on the environment and safety of personnel, the profitability of the business and quality of the product in order for the staff to be motivated.

Motivation is the willingness of action especially in behavior. Bin (2012) described motivation as incentive or reasons for carrying out an action. Moghimi *et al.*, (2015) revealed many strategies for motivating hospital staff such as posters, labels, stickers, banners to save energy, design periodical energy program on saving energy, create specific team for energy saving practices and many more. If the hospital fails to motivate staff towards electrical energy savings, they might not practice the electrical energy saving approaches which will lead to high electricity tariff and may as well reduce the life span of appliances and devices in the hospital. It is on this basis that the study is designed to identify the electrical energy saving approaches adopted in general hospitals in Kogi State, Nigeria.

1.2 Statement of the Research Problem

The healthcare delivery system of a nation hinges amongst other things, on how well its hospitals can deliver qualitative and affordable healthcare to its citizens. Thus, the role of hospitals in the healthcare delivery system of a nation cannot be overemphasized (Ojo & Popoola, 2019). This make hospitals depend heavily on supply of electrical energy for effective delivery of its functions. Patients need around–the-clock care and life saving equipment needs a constant power supply. While some buildings can be energy efficient in usage, hospital buildings because of healthcare facilities do have difficulty in electrical energy efficiency.

However, it has been noticed that the rate at which general hospitals misuses electricity every day is on the increase (Mkalaf, 2018). Beamon and Messer, (2018) reported that most of the equipment such as Medical Technical Equipment (MTE), are not properly managed by the hospital staff, as well as proper maintenance and carrying out electrical energy saving approaches. The general hospital staff leaves machines and equipment unplugged while not in use thereby consuming energy unnecessarily which may lead to high cost of bills. This do not seem to be a source of concern or worry to the hospital staff because such bills are been taken care of by the government (Mkalaf, 2018).

different appliances and devices in use. Some areas are updated with a new Heating, Ventilation, and Air Conditioning (HVAC) system or new and more energy-efficient lighting, for example, others remain outdated and use energy inefficiently. Bearing in mind that there is increase in death rate and casualties as a result of the shortage supply and mismanagement of electricity to the hospitals necessitates the adoption of more energy-efficient approaches and therefore, the study determined energy saving approaches adopted in general hospitals in Kogi State with the view to improve energy efficiency among technician, healthcare personnel as well as occupants of general hospitals in the state for effective delivery of health care services.

1.3 Aim and Objectives of the Study

The aim of the study was to undertake electrical energy saving approaches adopted in general hospitals in Kogi State. The study specifically determined the:

i. Electrical energy efficiency appliances used in General Hospitals in Kogi State
ii. Maintenance practices adopted for efficient electrical energy saving in General Hospitals in Kogi State
iii. Attitude of hospital staff towards electrical energy saving in General Hospitals in Kogi State
iv. Electrical energy appliances refurbished in General Hospitals in Kogi State
v. Ways staff are motivated towards electrical energy savings in General Hospitals in Kogi State

1.4 Significance of the Study

This study is of great benefit to hospital management board, patients, maintenance unit of the hospital, power provider, academic scholars, and the general public.

The hospital management board benefits from the findings of this work as they find the recommendations handy in reducing the hospital electrical energy consumption. This research can get to the hospital management board when the researcher publishes the article through journals and health magazines.

If the finding of this study is implemented, the patients in the hospitals will greatly benefit. Light may be available 24 hours, test results will come out faster, operation and other medical delay as a result of lack of electrical energy can be avoided. Patients will have comfortable rooms with smart lighting controls and programmable Heating, ventilation and air conditioning (HVAC).

Maintenance unit of the hospital will benefit from the findings of this research. They will be abreast with new technology and new techniques in energy efficiency. This should help them in better understanding of the hospital energy management which will consequently result in reduction of overall head cost of the hospital electrical consumption bill.

Power providers will greatly benefit from the implementation of the findings of this research. Because, when hospitals which consume large amount of electrical energy produced implements electrical energy efficiency strategies, there is percentage management drop which will be noticed by the power providers and thereby designate saved electrical energy to other customers that are deprived of getting electricity and as well make more money.

There are few materials in the field of electrical energy efficiency management in hospitals, especially in Nigeria hospitals. Academic scholars interested in this field will find the materials published from this research as a useful source in conducting further research. The published materials from this research can also be useful to scholars in area of guiding stakeholders in electrical energy management.

Most innovation in technology and source are targeted towards improving the living condition of individuals and the general public. The general public is therefore the end-user beneficiaries of many research and innovations. The benefits derived from this research is not an exception if the cost of hospital electrical energy consumption is reduced, the head cost for individual patient will reduce, many will be able to foot their medical bills and the mortality rate due to shortage of electricity supply to power appliances and devices in the hospitals will be reduced. This will consequently improve the overall wellbeing of the society.

1.5 Research Questions

The following research questions guided the study;

1. How are the electrical energy efficiency appliances used in General Hospitals in Kogi State.?
2. What are the maintenance practices adopted for efficient electrical energy saving in General Hospitals in Kogi State?
3. What are the Attitudes of hospital staff towards electrical energy saving in General Hospitals in Kogi State?

4. How recent was electrical energy appliances refurbished in General Hospitals in Kogi State?
5. How are staff motivated towards electrical energy savings in General Hospitals in Kogi State?

1.6 Scope of the Study

This study was delimited to energy efficiency of Heating, Ventilation, and Air-conditioning (HVAC), as well as lighting system. Other aspect of electrical energy efficiency such as ICT equipment's and sterilizers were not covered as these uses little electrical energy when compared to HVAC and lighting system.

1.7 Hypotheses

The following hypotheses were tested at 0.05 level of significance;

Ho_1: There is no significant difference among the mean responses of staff on the electrical energy efficiency appliances used in General Hospitals in Kogi State.

Ho_2: There is no significant difference among the mean responses of staff on the maintenance practices adopted for efficient electrical energy saving in in General Hospitals in Kogi State.

Ho_3: There is no significant difference among the mean responses of staff on the attitudes towards electrical energy saving in General Hospitals in Kogi State.

Ho_4: There is no significant difference among the mean responses of staff on the electrical energy appliances refurbished in General Hospitals in Kogi State.

Ho_5: There is no significant difference among the mean responses of staff on the motivations towards electrical energy saving in General Hospitals in Kogi State.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Theoretical Framework

2.1.1 Theory of reasoned action

The theory of reasoned action (TRA) is a general theory of behavior that was first introduced in 1967 by Martin Fishbein, and was extended by Fishbein and Icek Ajzen (Fishbein & Ajzen 1975; Ajzen & Fishbein 1980). Developed largely in response to the repeated failure of traditional attitude measures to predict specific behaviors, the theory began with the premise that the simplest and most efficient way to predict a given behavior was to ask a person whether he or she was or was not going to perform that behavior. Thus, according to the theory which is illustrated in figure 2.1, performance or non-performance of a given behavior is primarily determined by the strength of a person's intention to perform (or not to perform) that behavior, where intention is defined as the subjective likelihood that one will perform (or try to perform) the behavior in question. Behavior intention is affected by the attitude and subjective norm; attitude is extent of supporting behavior. Subjective norm refers to the external pressure to perform or not to perform a certain behavior.

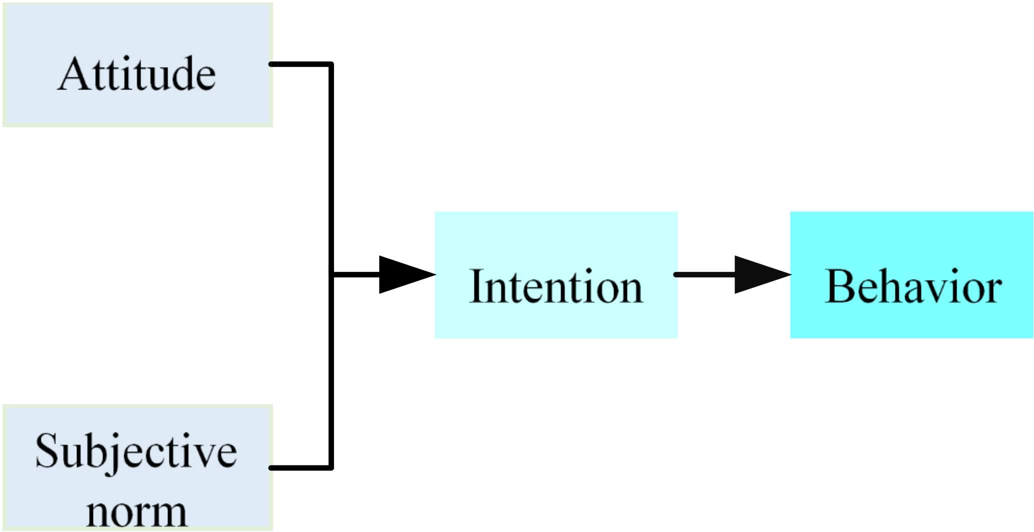

Figure 2.1: Theory of Reasoned Action (Fishbein & Ajzen 1975)

The contribution of the theory of reasoned action is to consider the social factors such as the subjective norm, it means behavior is not only affected by their own attitude but also by the outside world.

Many scholars have constructed energy consumption behavior model based on theory of reasoned action. Hagger (2019) used the TRA (theory of reasoned action) to construct the framework, which designed to display process of public green purchase intention. In this model, the researchers supposed that public's willingness to buy environmental product is influenced by environmental knowledge, environmental awareness, environmental attitude, peer pressure and the energy label. The researchers hypothesized that: (1) Environmental knowledge, environmental awareness, environmental attitude and behavior intention indirectly influenced people's behavior by means of peer pressure. (2) Environmental knowledge, environmental awareness, environmental attitude, and peer pressure had positive impact on behavior intention. These hypotheses were verified by constructing a structural equation model. The final analysis results showed that environmental knowledge, environmental awareness, environmental attitude and peer pressure played a positive role in promoting green energy purchase intention, and environmental label on green had a negative impact on energy purchase. However, economic background and technological development also have significant influence on green purchase intention. In this sense, environmental knowledge, environmental awareness, environmental attitude, peer pressure, energy label, economic background and technological development form a more practical framework, and many scholars have done many researches under this framework. Pothitou *et al*., (2000) gave attention to the impact of knowledge about environmental, attitudes, habits and energy issues on potential pro-environmental behavior in households. The results showed that significant correlations which indicate that residents with positive environmental values and greater environmental knowledge were more likely lead to energy-saving behavior. Testa *et al.*, (2016) researched the determining factors behind individuals' decisions to purchase energy saving products.

This theory relates to this study as it seeks to educate and motivate staff in general hospitals on the electrical energy saving approaches, its benefits and importance to the hospital. It educates the staff on the effect of electrical energy wastage as it tends to result to increase in tariff from power generation sector. This also points out the implementation of electrical energy storage systems to be considered for the diffusion of innovative technologies and comparison between innovative technologies and traditional technology.

2.1.2 Theory of planned behaviour

In 1991, Ajzen proposed the theory of planned behavior (TPB), which was an extension of the theory of reasoned action (TRA). According to the theory which is illustrated in figure 2.2, there exists a complicated psychological process behind the individual behaviour. The behaviour is the results of a series of mental processes. The actual behavior is decided by behaviour intention, and the behaviour intention is affected by the attitude, subjective norms and perceived behavioural control. Behavioural attitude is extent of a person's support or not support a behaviour. Subjective norm refers to the social pressure that people perceives when to decide whether or not to perform a particular behaviour. Perceived behavioural control refers to the ability to perform a behaviour. Accurate perception behaviour control reflects the actual control conditions, it can be used as an alternative measure of the actual control conditions, so it can also be used as a direct impact on the behavior. The accuracy of the prediction depends on the perceived behavioural control. Individual and social cultural factors such as personality, intelligence, experience, age, gender and cultural background affect the behaviour intention and behaviour indirectly through behaviour control behaviour attitude, subjective norm and perceived behavioural control.

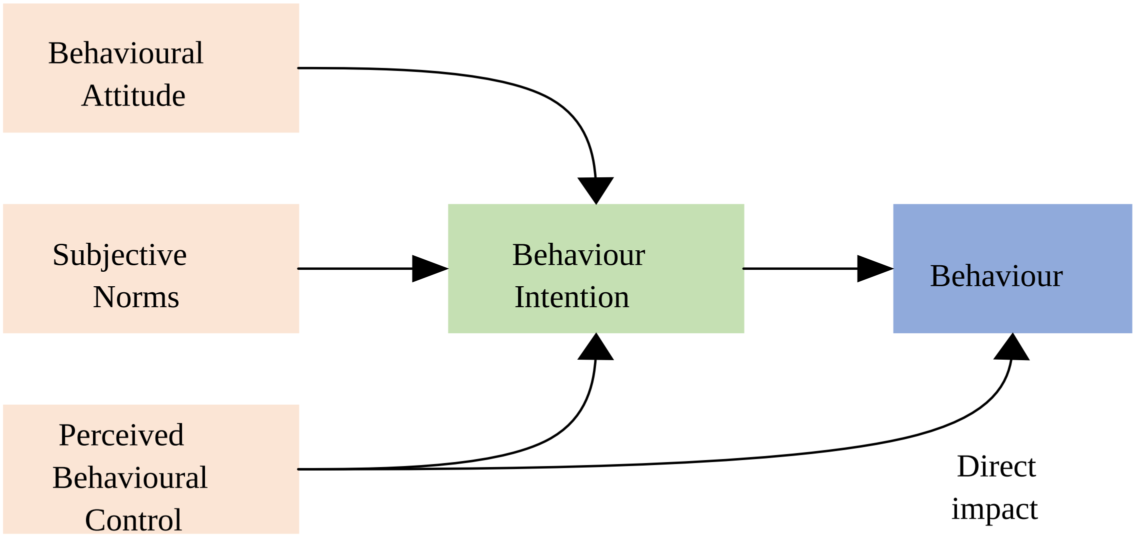

Figure 2.2: Theory of Planned Behaviour (Ajzen & Fishbein 1980)

Some scholars have done a lot of researches on psychological processes hidden behind the residential electricity behaviour according to the theory of planned behaviour. Elliot and Ainsworth (2012) used the theory of planned behaviour to do a survey of energy usage through a series of questions that are related with beliefs in British Yorkshire and Humber area. They measured the relationship between people's attitudes and the rate of adopting energy-saving device. The results showed that: (1) People who use energy saving devices easier were worried about abnormal changes in the global temperature. (2) The extent of familiarity with energy-saving device had impact on the rate of using energy saving devices. Residents were more willing to use familiar energy-saving devices. (3) As far as different energy-saving devices, the respondents showed significantly different in the behavioural attitude, subjective norm, and perceived behavioral control.

Based on the theory of planned behavior, Abrahamse and Steg (2000) put forward the following hypothesis. (1) There was a strong correlation between household energy consumption and social demographic characteristics (such as income, family population). (2) Energy consumption was mainly determined by psychological factors. The results of regression analysis showed that the use of household energy was determined by demographic factors. Yazdanpanah *et al.*, (2015) studied on the relationship between social psychological factors and renewable energy. Researchers concluded that the social psychological factors (such as behavior, perception, and subjective norm) had significant impacts on the adoption of the Energy Sources Renewable (RES) project. The researchers collected information from 260 students by questionnaires. The relationship between attitude toward RES, behavior attitude, perceived behaviour, subjective norm and behaviour intention was analyzed by means of structural equation model. The final results showed that the code of ethics and behaviour attitude and perceived behavioural control significantly affected the residents' willingness to use renewable energy, but subjective norm and self-recognition did not significantly affect attitude toward renewable energy.

The theory relates to the present work as it shows that environmental concern and attitude, subjective norm, perceived behavioural control and purchase intention were positively correlated. Therefore, environmental concern can indirectly affect purchase intention through attitude, subjective norm and perceived behavioural control, and it can also directly affect the purchase intention. So when a staff has a positive attitude towards electrical energy savings, proper usage of electricity supply will be carried out thereby reducing financial cost of power supplies.

2.2 Conceptual Framework

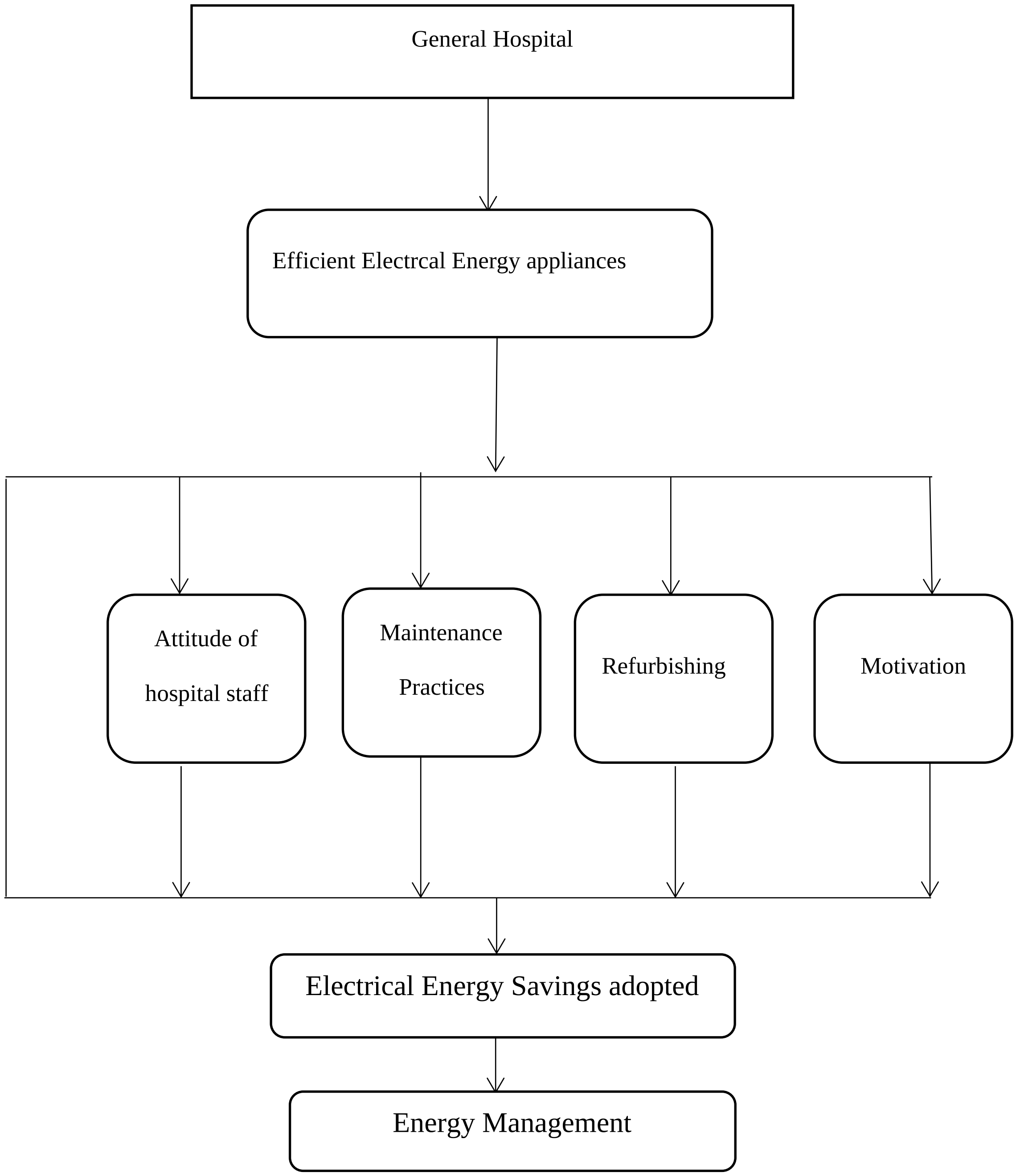

Figure 2.3: Schematic conceptual model developed by the researcher

2.2.1 The general hospital

A general hospital is a hospital owned by the government in which patients with different types of ailments are given appropriate care. General Hospitals have the provision for accident and emergency unit and diagnosis unit [including X-ray, scan machines and other pathological services] among other services (Badru 2018). According to the Medical and Dental Council of Nigeria, there should be a minimum of three doctors who are to provide medical, surgical, paediatric and obstetric care in any General Hospital. Furthermore, the General Hospitals incorporates the facilities of the primary healthcare into its own to play its role as a second-tier health institution (Ademiluyi & Aluko-Arowolo 2019). To be qualified a General Hospital, it should provide simple surgical services, supported by beds and bedding for minimum of 30 patients, all of which require energy for it efficient runnings. General Hospitals are often within the control of state governments and are social designed to work 24hours per day.

The electrical energy system of a hospital organization is usually exceptionally complex and must respect strict regulations, since any changes to the performance have impact on other aspects. For instance, the indoor climatic conditions, ventilation and lighting level are determined by the activities and special functions the specific area is addressed for, and once those constraints are established, it is of crucial importance to provide the required climate, lighting and ventilation in the most sustainable way. In addition, the typical hospital building is designed for long-term use and, in practice, is often utilized for longer periods than planned. During its life time period, frequently over 50 years, the building is retrofitted and renewed many times, in order to deal with the replacement of obsolete technical equipment, the development of new equipment, new energy regulations and saving technologies, different use of specific areas, as well as the ageing of the building itself (CADDET, 2011).

The electrical energy system of a hospital organization is usually exceptionally complex and most respect strict regulations, since any changes to the performance have impart on other aspects. For instance, the indoor climatic conditions, ventilation and lighting level are determined by the activities and special functions the specific area is addressed for, and once those constraints are established, it is of crucial importance to provide the required climate, lighting and ventilation in the suitable way. When considering energy-efficiency in hospitals, it is important to keep in mind that it is not the end-use of energy alone, but also the need to control the indoor climate, that is one of the principal requirements. In practices energy efficiency is increasingly becoming important requirement, but medical considerations remain the top priority in the hospitals.

2.2.2 Energy efficiency in hospitals

The unsteady and epileptic nature of power supply in Nigeria necessitate that users of electricity in hospital manage electrical energy more efficiently in order to maximized it full potentials. Energy efficiency means an improvement in practices and products that reduce the energy necessary to provide services. Energy efficiency appliances/devices essentially help to do more work with less energy (Oyedepo, 2018) Energy efficiency is also defined as essentially using less energy to provide the same service (Rosen, 2019) In this sense, energy efficiency can also be thought of as a supply of resource - often considered an important, cost-effective supply option. Investment into energy efficiency can provide additional economic value by preserving the resource base (especially combined with pollution prevention technologies) and mitigating environmental problems for hospitals.

Efficient energy use, sometimes simply called energy efficiency, is the goal to reduce the amount of energy required to provide products and services. For example, insulating a home allows a building to use less heating and cooling energy to achieve and maintain a comfortable temperature. Installing LED lighting, fluorescent lighting, or natural skylight windows reduces the amount of energy required to attain the same level of illumination compared to using traditional incandescent light bulbs. Improvements in energy efficiency are generally achieved by adopting a more efficient technology or production process by application of commonly accepted methods to reduce energy losses (Diesendorf, 2019).

There are many motivations to improve energy efficiency. Reducing energy use reduces energy costs and may result in a financial cost saving to consumers if the energy savings offset any additional costs of implementing an energy-efficient technology. Reducing energy use is also seen as a solution to the problem of reducing greenhouse gas emissions. According to the International Energy Agency, improved energy efficiency in buildings, industrial processes and transportation could reduce the world's energy needs in 2050 by one third, and help control global emissions of greenhouse gases (Forkel, 2017).Another important solution is to remove government-led energy subsidies that promote high energy consumption and inefficient energy use in more than half of the countries in the world (Benkova, 2017).

Energy efficiency has proved to be a cost-effective strategy for building economies without necessarily increasing energy consumption. For example, the state of California began implementing energy-efficiency measures in the mid-1970s, including building code and appliance standards with strict efficiency requirements. During the following years, California's energy consumption has remained approximately flat on a per capita basis while national US consumption doubled (Zehner, 2019). As part of its strategy, California implemented a "loading order" for new energy resources that puts energy efficiency first, renewable electricity supplies second, and new fossil-fired power plants last. States such as Connecticut and New York have created quasi-public Green Banks to help residential and commercial building-owners finance energy efficiency upgrades that reduce emissions and cut consumers' energy costs (Kennan, 2019).

Lovin's (2018), Rocky Mountain Institute points out that in industrial settings, "there are abundant opportunities to save 70% to 90% of the energy and cost for lighting, fan, and pump systems; 50% for electric motors; and 60% in areas such as heating, cooling, office equipment, and appliances." In general, up to 75% of the electricity used in the US today could be saved with efficiency measures that cost less than the electricity itself, the same holds true for home settings. The US Department of Energy has stated that there is potential for energy saving in the magnitude of 90 Billion kWh by increasing home energy efficiency.

A report published by Baily *et al.*, (2016) in the McKinsey Global Institute, asserted that "there are sufficient economically viable opportunities for energy-productivity improvements that could keep global energy-demand growth at less than 1 percent per annum" less than half of the 2.2 percent average growth anticipated through 2020 in a business-as-usual scenario (Horner & Azevedo, 2016). Energy productivity, which measures the output and quality of goods and services per unit of energy input, can come from either reducing the amount of energy required to produce something, or from increasing the quantity or quality of goods and services from the same amount of energy.

From the point of view of an energy consumer, the main motivation of energy efficiency is often simply saving money by lowering the cost of purchasing energy. Additionally, from an energy policy point of view, there has been a long trend in a wider recognition of energy efficiency as the "first fuel", meaning the ability to replace or avoid the consumption of actual fuels. In fact, International Energy Agency (2014) has calculated that the application of energy efficiency measures in the years 1974-2010 has succeeded in avoiding more energy consumption in its member states than is the consumption of any particular fuel, including oil, coal and natural gas.

Moreover, it has long been recognized that energy efficiency brings other benefits additional to the reduction of energy consumption (Weinsziehr & Skumatz, 2016). Some estimates of the value of these other benefits, often called multiple benefits, co-benefits, ancillary benefits or non-energy benefits, have put their summed value even higher than that of the direct energy benefits. These multiple benefits of energy efficiency include things such as reduced climate change impact, reduced air pollution and improved health, improved indoor conditions, improved energy security and reduction of the price risk for energy consumers. Methods for calculating the monetary value of these multiple benefits have been developed, including e.g. the choice experiment method for improvements that have a subjective component (such as aesthetics or comfort) and Tuominen-Seppänen method for price risk reduction. (Baatz, and Barrett, 2018) When included in the analysis, the economic benefit of energy efficiency investments can be shown to be significantly higher than simply the value of the saved energy.

2.2.3 Electrical energy consuming devices in hospitals and efficiency

Heating, Ventilation and Air Conditioning: A large portion of the energy that was consumed by the hospital that was studied came from the heating, ventilation and air conditioning (HVAC). The hospital had two large chillers that provided the air conditioning for the entire hospital. One chiller had a capacity of 500 tons and the other had a capacity of 700 tons. These chillers were located onsite in the basement of the facility. The hospital also had eight steam generators for heating purposes. These generators ran on either oil or gasoline. The equipment could transition between the two fuel types depending on which fuel type was more economical in the current situation. Even during warmer months, the hospital must maintain one of the steam generators for the purpose of sterilizing medical equipment. During the warmer months, the steam was kept at 115˚F and during the winter, the steam was heated to 180-190˚F.

Electronics and Computer Equipment: The computer equipment located in the hospital was standard equipment that was similar in energy usage to equipment that could be found in many office complexes. As of the time when this study was conducted, there was no strong market for energy efficient computer equipment. Because of this, the payback period for replacing the computer equipment would be far too long to make the improvements economically feasible. This study did not investigate the replacement of any computer equipment or electronics. There will be a discussion later in this report about practices that the hospital employees can use to reduce the energy use of the existing equipment.

Medical Equipment: There are medical devices such as medical surgical operation trolley, COVID-19 medical ventilator, advanced ICU ventilator that use electricity to function than what the hospital had, however many of these machines and equipment had a very high initial cost associated with purchasing them. Because of this, the team chose not to investigate the energy consumption of medical devices. The team did recommend that the hospital staff consider the environmental benefits when selecting new equipment during the routine replacement of supplies and equipment.

Miscellaneous Equipment: The final category of equipment that used energy was the miscellaneous equipment that was vital to the operation of the hospital. This included a range of different equipment including the elevators, the smoke alarms, the food preparation appliances, the vending machines and a number of other devices. As with the medical equipment, the team determined that it would not be cost justifiable for the hospital staff to replace most of these devices due to the large initial costs associated with purchasing new equipment. In addition, replacing industrial sized refrigerators and the equipment needed to run the elevators would be a project that would go beyond the scope of the hospital's current energy saving improvement initiative.

There was one area of improvement that the research team investigated in this category, however. It was determined that investigating the energy use of the exit signs throughout the hospital was feasible due to the large number of the signs. It was also relatively simple to make improvements to the signs. While there were several varieties of exit signs located throughout the hospital, the most common variety was the sign that consumed 6.5 Watts. These signs were left on 24 hours a day and 365 days a year as mandated by law. The research team did not take a full inventory of the signs, but estimated that there were approximately 215 exit signs throughout the inside of the hospital facility.

The great interest in electrical energy efficiency in hospitals is demonstrated by the high number of documents produced by public organizations (Kolokotsa *et al.,* 2019) and private companies about both energy and best practice guides for energy efficiency in hospitals (Siemens, 2019).

Different energy-saving measures are proposed by various researchers (Qahtan *et al.*, 2020). For example, high-efficiency electrical motors with variable-speed drives can save up to 1–3 per cent of the total electricity consumption (Saidur *et al.,* 2010). Moreover, the use of light-emitting diode (LED) lighting in hospitals and its contribution to energy efficiency is underlined and proposed by Matsushima *et al.,* (2010). Regarding building services for hospitals, a series of studies can be found. The role of advanced systems like Combined Heat and Power (CHP) is considered in the literature (Ruan *et al.,* 2019) since CHP system is an attractive option for large complex buildings. The specific study analyses the Building CHP (BCHP) technology's contribution in energy efficiency for hospitals through the evaluation and comparison of various scenarios in terms of heat-to-power ratio by the estimation of their contribution to energy utilization efficiency, energy saving and environmental effects, as well as economic efficiency. Results show that hospitals are the most attractive buildings for BCHP because of their stable thermal load demands and a favourable heat-to-power ratio.

Moreover, Aquifer Thermal Energy Storage (ATES) system combined with a heat pump was installed and monitored in a Belgian hospital. The energy analysis showed that the primary energy consumption of the heat pump system is 71 per cent lower in comparison with a reference installation based on common gas-fired boilers and water cooling machines (Vanhoudt *et al.*, 2017). The contribution of fuel cells (FCs), photovoltaic (PV) systems and solar thermal systems for hospitals and the environmental benefits of such installation in a hybrid concept are analysed by Bizzarri and Morini (2006). The results, presented with reference to the primary energy requirements and the pollutant emissions, demonstrate that, in all the cases, these retrofit policies could offer a significant greenhouse gas emission reduction. The main considerable problem was the cost of the presented systems making their application dependent from public funds. Solar cooling systems for hospitals are studied by Tsoutsos *et al.*, (2010). The major benefit of solar absorption cooling is the fact that it is environmentally friendly and contributes to a significant decrease of the CO_2 emissions. Another critical parameter is the increased ventilation rates required in hospitals in order to reduce cross-infection risk of airborne diseases in the various areas. The contribution of natural ventilation as an energy-efficient technique for hospitals was studied by Qian *et al.*, (2020).

Natural ventilation is found that can deliver a much higher ventilation rate than mechanical ventilation in an energy-efficient manner reducing cross-infection of airborne diseases, and thus it is recommended for consideration of use in appropriate hospital wards for infection control. In the same context and by taking into consideration the promotion of natural ventilation by the UK National Health Service (NHS), the perceived barriers to the implementation of more naturally driven environments in healthcare buildings are discussed by Almaiyah and Short (2019). Environmental design is proposed, catalogued and aggregated into a typical plan component and their ventilation and energy performance is modelled. The authors suggest that up to 70 per cent of net floor area of small-to-medium-sized hospitals could be naturally ventilated while patients and staff may benefit from more naturally sustained environments. Finally, the critical role of indoor environmental quality in hospitals is studied by Dascalaki *et al.*, (2019) through audits and a monitoring campaign of 18 operational rooms of hospitals. The personnel reported health symptoms related to indoor comfort conditions and indoor air quality. The perception of satisfactory comfort conditions reduces the average number of health complaints and improves the working conditions, even in a demanding environment.

Life cycle analysis coupled with mixed integer linear programming optimization technique was examined considering the hospitals energy demands and operational profiles (Carvalho *et al.*, 2011). A CHP system with additional components highly interconnected was optimized using the aforementioned methodology considering the energy demands. The objective functions took into account CO_2 emissions, the Eco-indicator 99, the price of energy resources, the price and amortization possibilities of the equipment and options for selling surplus electricity to the grid. The configuration of the system is found to be strongly influenced by the correlation of the local electricity emissions and natural gas emissions.

However, information and communication technology for energy management in hospitals has evolved considerably the last decades. Advances in the design, operation optimization and control of energy-influencing building elements (for example. HVAC, solar, FCs, CHP, shading, natural ventilation) unleashed the potential for realization of significant energy savings and efficiencies in the operation of existing building sites worldwide. Currently, the issue of energy management for hospital buildings is addressed by the Building Energy Information Systems (EIS) which have evolved out of the electric utility industry in order to manage time-series electric consumption data (Kolokotsa *et al.*, 2017). Artificial intelligence and advanced decision support techniques (Diakaki, *et al.*, 2018) have been incorporated targeting to the minimization of energy demand by giving priority to passive techniques (natural ventilation, day lighting, shading, etcetera) (Kolokotsa *et al.,* 2019).

Furthermore, other materials, already used for other buildings, such as phase change materials (PCM) could be integrating in different construction elements and improve the energy efficiency minimizing the thermal mass of the building (in modern building constructions thermal improvement approaches 62 per cent), of the initially required heating energy (Gkouskos *et al.,* 2010). As concerns, the perspectives of the adoption of innovative technologies and techniques in buildings, it has to be noted that the most common problems are the lack of information and knowledge, and the lack of economic incentives (Karkanias *et al.,* 2018).

Therefore, notwithstanding the complex situation, the strict regulations and the 24/7h operability, recent studies clearly demonstrate that the potential for energy savings in hospitals is very high, estimated to range from 20 to 50 per cent. Those savings in terms of energy consumption can be reached by hospital organizations through two different and complementary ways: Refurbishment of buildings or building areas can be performed, adopting most advanced and efficient technical solutions (new materials, building services and more efficient technical components). The hospital building users (patients, medical and nurse staff, administrative staff) can be made aware of energy inefficiencies and trained for a more efficient use of energy resources.

2.2.4 Hospital maintenance practices

The healthcare sector is usually considered among the important sectors in any country (Sweis, *et al* 2013; Sweis, 2015). A hospital building is a place where patients heal, so keeping the hospital in a good condition is a very important issue to ensure a healthy and safe environment. The main reason of poor hospital buildings state is the lack of maintenance (Mirdeeliana, 2012). It is said that the qualitative aspect of the building is the matter of maintenance (Adenuga, 2012). According to the British Standard (BS 3811) (as cited in Ogunmakinde *et al.,* (2013) and Olayinka and Owolabi, 2015), maintenance is defined as any work carried out to maintain or return every facility of the building. In a deeper view, it is defined as the combination of all technical and administrative procedures planned to restore an item to, it should be taken into consideration in any risk management plan (Jandali *et al.,* 2017), retain it to, its acceptable condition, so it can perform its required function well. It has been stated that building maintenance with the required standards extends the life span of the building and achieves better sustainability. Besides, it provides a safety environment for all users (Tan, 2014).

In order to execute maintenance activities efficiently, a suitable maintenance plan should be set (Ali *et al.,* 2020). Maintenance management is responsible for using tools and methods to improve the efficiency and to reduce the effects of unplanned stoppages and to reduce costs (Oliveira *et al.,* 2014). The maintenance of hospital buildings is a major issue. It is the last controllable task and sometimes as unnecessary task, which leads to a low level of reliability and operating capacity. Not giving maintenance management in hospital buildings a high priority has led to the deterioration of these hospitals and to the reduction of the health care services. It has an important role among other activities in buildings' operations. It should be taken into consideration to improve the performance of these hospitals, their facilities, and the quality of delivered services. In addition, to avoid expending the scarce resources which could be better utilized.

The Chartered Institute of Building has listed some steps to help in improving maintenance management practices (as cited in Fakhrudin *et al.*, 2011) as follows:

a) Having a well trained and experienced maintenance staff;
b) Using maintenance programs which include the standards and response time;
c) Keeping all records from sites, renewal dates, service agreements, buildings, redecoration, engineering service, and costs, and;
d) Using the best methods to spread information to help in reducing cost and failures that caused them.

Meeting the requirements of the building users and satisfying them and maintaining all building facilities are the result of effective maintenance practices. A study assessed the practices of maintenance management in government office buildings and concluded that maintenance practices is one of the most important issues that should be taken into consideration (Husaini & Tabassi, 2014). Besides, they recommended some important issues that would result in improving these practices, maintenance should be carried out efficiently. Maintenance department should be responsible for carrying out all maintenance works and taking all complaints from all users seriously. The maintenance program should be reviewed to check what maintenance problems have been solved and how to solve all remaining problems.

The practices of maintenance management in banking industry were studied by Faremi and Adenuga (2012) through evaluating the operational state of the buildings, and the factors affecting maintenance management. Their results showed that the buildings were in a good condition according to the users and maintenance staff perception. Nevertheless, the old generation buildings were in a poor condition in comparison with the new generation buildings. Besides, attitude of users and misuse of facilities and lack of discernable maintenance culture in the country were the most significant factors affecting maintenance management. They recommended that all factors affecting maintenance management should be checked to avoid any problems. Enshassi *et al.,* (2015) evaluated the practices of maintenance management in public hospitals in the Gaza Strip. They found that the application of corrective maintenance was done in most hospitals, while preventive maintenance is applied in few hospitals. They also found that there were variances in responding to maintenance requests because of the unqualified maintenance staff and the lack of spare parts. Furthermore, most of the hospitals did not have a maintenance program. They stated that it is the responsibility of the maintenance department to preserve all the facilities and elements of the building, and to make sure that the supporting systems are operating effectively. Finally, they recommended that the maintenance staff should have the required experience and they should be well trained to do their jobs effectively. Besides, all hospitals should have an inventory for all spare parts to respond immediately to any maintenance request.

Any healthcare organization needs a maintenance program in order to manage all facilities according to Alzaben (2015), it also needs to carry out maintenance at regular intervals to ensure the safety of users and patients and to make sure that the building is operating within specifications. Adenuga (2012) studied the practices of maintenance management in public hospital buildings, and identified the necessary skills for an effective maintenance manager in a hospital. The researcher found that there was a weakness in the maintenance department and the staff is inexperienced, the users of these hospitals were not trained on effective use of hospital facilities. Finally, he established the cause of low motivation in executing the desired maintenance programs.

2.2.5 Electrical energy usage/consumption in hospitals

Electrical energy consumption in the world today shows that Nigeria and indeed African countries have the lowest rates of consumption. Nevertheless, Nigeria suffers from an inadequate supply of usable energy due to the rapidly increasing demand, which is typical of a developing economy. Paradoxically, the country is potentially endowed with sustainable energy resources. Nigeria is rich in conventional energy resources, which include oil, national gas, lignite, and coal. It is also well endowed with renewable energy sources such as wood, solar, hydropower, and wind (Okafor & Joe-Uzuegbu, 2020).

The energy consumption per capita in Nigeria is very small - about one-sixth of the energy consumed in developed countries. This is directly linked to the level of poverty in the country. Gross domestic product (GDP) and per capita income are indices that are used to measure the economic well-being of a country and its people (Karekezi, 2017). GDP is defined as the total market value of all final goods and services produced within a given country in a given period of time (usually a calendar year). The per capita income refers to how much each individual receives, in monetary terms, of the yearly income that is generated in his/her country through productive activities. That is what each citizen would receive if the yearly income generated by a country from its productive activities were divided equally between everyone.

The typical energy flows in a hospital according to Van Heur and Verheijen, (2018) are as follows:

i. **Heating:** as steam is used for the kitchens, humidification in HVAC (heating, ventilation, and air conditioning) and sterilization; in addition is used to transport heat over longer distances. Hot water is used in the form of central heating and tap water.

ii. **Electricity:** the largest electricity consumers are lighting, cooling machines, air compressors, circulation pumps, HVAC fans, medical equipment and office equipment.

iii. **Compressed air:** Medical compressed air refers to direct treatment and care of patients (i.e. breathing apparatus and surgical tools) and is subject to very high standards for availability and quality. Other compressed air falls under the heading of technical compressed air (HVAC control systems, workshop applications or keeping containers under pressure).

iv. **Cooling:** mainly in climate control systems, for cooling and drying the ventilation air.

The total and the percentage composition of energy consumption depend on several factors, like the dimensions of the hospital organization, the activities and specific areas the organization is composed of and the geographic localization. Figure 2 reports the typical breakdown of energy between fossil fuels and electricity use in a good practice hospital with 500 beds (Kolokotsa *et al.*, 2012). In modern hospital buildings, the HVAC system, ICT data centers and personal small power are among the greatest consumers of electricity. New hospitals often have proportionately more air conditioning and more extensive ventilation system compared with older buildings. Fuel is mostly used for room heating and to produce domestic hot water. HVAC and lighting alone are estimated to account for 50–60 per cent of the total electrical energy consumption.

As expected in hospitals, clinics and extended care operations exist, that require unique energy demands not common for other organizations. There is an increased fluctuation of energy consumption of hospitals, due to different reasons:

- The use (general, psychiatric, health Centre)

- The constitution year and the status of the building envelope
- The insulation levels
- The climatic zone
- The age and level of maintenance of the mechanical equipment. The level of the energy management.

Only 8 per cent of the hospitals (mainly the health centres) consume annually, 200kWh/m^2, 56 per cent between 200 and 400kWh/m^2 and 36 per cent consume .400kWh/m^2. In Greece, the average consumption (based on 1.500 degree days) is 290kWh/m^2/year; in France, it (with 2.500 degree days) is 330–345kWh/m^2/year. Hence, the consumption in the Greek hospital was estimated to be very high. The Figure 2.4 shows the typical breakdown of energy use in agood practice hospital.

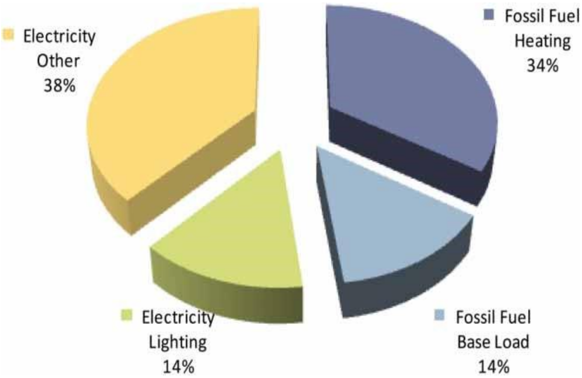

Figure 2.4 Typical breakdown of energy use in a good practice hospital

Table.1.1 shows the unique chacteristics for high energy use at healcare facilities.

Table 1.1 Unique characteristics for high energy use at healthcare facilities

Energy Used	Characteristics
High-Efficiency Particulate Air (HEPA)	HEPA filtration is required to prevent the spread of disease (also known as nosocomial infection) in the ventilation system
	HEPA filters that achieve 99.7% efficiency place greater electric demand on fans for proper air circulation
Indoor Air Quality (IAQ)	IAQ levels must be maintained, especially in operating rooms (OR), emergency rooms (ER), intensive care units (ICU) and laboratories. These rooms require 20–30 air changes per hour
	Certain types of rooms have special HVAC pressurization requirements. ORs, ERs and ICUs generally run over-pressure for protective isolation from airborne infection. Quarantine rooms require negative pressure (and UV lights) for infectious isolation and the control of diseases.
	IAQ must be strictly regulated for temperature, humidity and quality. This increases the need for proper heating, cooling and fresh air intake
Domestic Hot water (DHW)	DHW must be heated to 1308F to kill Legionella bacteria. But then the water temperature has to be lowered to 1058F before use.
Climate Control	Some rooms require climate control set at 608F to accommodate the adhesive cement used for orthopaedics, which tend to set too quickly in warmer temperatures
Laundry Facilities	Laundry facilities and kitchens can consume 10–15% of the building's energy, increasing the need to more closely monitor hours of peak demand from these sources
High safety of energy supply	Hospitals require that power be provided at 100% uptime for patient care and liability concerns. Backup generators contribute to increased operating costs, or cogeneration (also known as combined heat and power, or CHP) investment may be necessary

Source: Sofronis and Markogiannakis (2016). Energy consumption in public hospitals

2.2.6 Energy saving approaches in hospitals

Because hospitals form the largest ratio of the area in the healthcare sector, the majority of studies evaluate end-use energy consumption and electrical energy-saving approaches at hospitals in different regions. In general, lack of reference values makes the evaluation of energy data in this sector a challenging task (Christiansen *et al.*,, 2016). The energy audit of a Malaysian hospital showed that lighting and biomedical equipment consumed the largest amount of energy (36% and 34%, respectively), and energy intensity was reported to be 234 kWh/m2 (Saidur, 2010). A study in Thailand determined the energy intensity of 148.8 kWh/m2, with air conditioning units accounting for 57% of the total amount of energy consumption (Chirarattananon *et al.*, 2010). In another study of 210 hospitals in Thailand, electricity and thermal energy accounted for 31.61% and 36.81% of total energy requirements, respectively (Thinate *et al.*, 2017). They also proposed a regression model to estimate energy consumption as a function of six predictors. Analyzing energy consumption data from two hospitals in Korea resulted in an electricity intensity of 0.46 GJ/m2 (128 kWh/m2) and a heat density of 1.63 GJ/m2 (452 kWh/m2) per year (Chung and Park, 2015). Hospitals in Spain were responsible for 7% of total energy consumption in the tertiary sector, and quantitative analysis of energy consumption in 20 hospitals concluded the energy intensity of 270 kWh/m2 (González *et al.*, 2018).

They also evaluated the impact of the area, the number of workers, the number of beds, the type of management, the geographical location, the gross domestic product (GDP), the heating and cooling degree days, and the range of years (study span) on energy consumption. Quantification of energy data in German hospitals was investigated in (González et al, 2018). They declared that 2100 hospitals in Germany consumed around 6000 kWh of electricity and 29,000 kWh of heat per bed per year. Energy-saving approaches in a 110-bed hospital in Grevena, Greece concluded the average energy intensity of its facility was 104.46 kWh/m2 (Bakaimis & Papanikolaou, 2017). In Germany, 20,000 h of data were collected for operating theaters, intensive care units, examination rooms, and large-scale medical equipment. The daily energy intensity ranged from 1.2 kWh/m2 for the operating rooms to 150 kWh/m2 for medical equipment (Chirarattananon *et al.*,2010). In the UK, the study of a 48-bed hospital determined total annual energy demand of 289 kWh/m2 and identified overheating in some areas during summertime (Fifield *et al.*,, 2018). They also investigated temperature and ventilation performances of the hospital.

While some studies analyze energy performance at a specific facility, Morgenstern *et al.*, (2016) studied electricity consumption data in 28 departments across eight medium-to-large general acute hospitals in England and confirmed that different departments have considerably nonhomogeneous electricity consumption characteristics. Studies conducted by Franco *et al.*, (2017) provided an estimation of the energy requirements in healthcare facilities by considering basic services such as lighting and heating, ventilation, and air conditioning (HVAC) equipment, and medical and laboratory equipment in non-critical, non-secured, and secured categories. They also reviewed different energy-production and energy-storage technologies for healthcare systems. Assessing 55 healthcare facilities in Spain sized from 500 to 3500 m2 area concluded an average annual energy consumption of 86 kWh/m2 and determined energy-saving opttions through simulation (García-Sanz-Calcedo, 2014). With this background, Section 3 summarizes some of the current energy facts in the U.S. healthcare systems.

2.2.7 Attitudes and behavior of hospital staff towards electrical energy efficiency

The energy consumption of hospital building is reported to be among the highest compared to commercial and residential buildings due to its 24 hour operation and intensive energy use of medical equipment's (WHO, 2010). Several energy audit studies revealed that the current energy performances of the public hospital buildings in Malaysia are not energy efficient (Moghimi *et al.*,2015; Saidur *et al.*,, 2010). Nisiforouss *et al.*, (2012), this study assessed the behavior, attitude and opinion on large enterprise employees with regards to their enery usage habits. The findings of their study revealed that majority of the employees acknowledge that there is waste of energy, which indicated a poor attitude on energy saving. In other countries, some hospital buildings are reported to reach up to more than 700kWh/m2 per year due to the different climate where energy use can be more for Heating Ventilation Air Conditioning (HVAC). Energy performance studies in Malaysia reported that lighting use is reported to have the highest energy use (approximately 36%), followed by the medical and office equipment's where it's energy use is approximately 60%(Moghimi *et al.*,2015; Saidur *et al.*,2010). The percentage of energy use for HVAC in the hospital building case studies is smaller with only 4% because the building is mostly ventilated using ceiling fans.

Majority of the literature examined the active and passive building design strategies in reducing energy use in hospital buildings. However, there are limited studies examining how to engage the building occupants to further reduce energy use. For example, previous research by Morgenstern *et al.*, (2016); Eusoff and Ismail, (2015) on occupant's behavior in reducing the standby mode of medical equipment's waste management), revealed the establishments of energy benchmarks for hospital buildings, analyzed the breakdown of energy use in hospital buildings adopted energy efficient technologies such as occupancy sensors, LED lights, variable air volume and adoption of a better energy monitoring system (Kamchuchat, 2013). Nisiforouss *et al.*, (2012), assessed the behavior, attitude and opinion on large enterprise employees with regards to their enery usage habits. The findings of their study revealed that majority of the employees acknowledge that there is waste of energy, which indicated a poor attitude on energy saving.

However, Saba *et al.,* (2016), carried out a research on Behavioural Approaches to Electrical Energy Management in Residential Buildings in Niger State, Nigeria. Their findings showed that, consumers in Niger state rarely adopted the following human behavioural practices; utilization of low wattage lamp to provide required light, usage of appropriate colour for walls and ceilings for better illuminations, switching off light when not in used and they also practiced electrical load management habits at very high extent among others. Although these various technical initiatives have shown successful cases in reducing the energy use of a hospital building, the lack of energy saving behavior practice can impede the energy efficiency performance of the buildings. For example, many energy performance studies in green buildings are reported to not achieve its optimum energy efficiency performance due to lack of energy saving behavior practice (Moghimi *et al.,* 2015; Saidur *et al.,*2010). According to the Pareto Principle, 20% of occupants control 80% of the energy use in the building Several international case studies of hospital buildings that participated in the Global Green and Healthy Hospital Programme by the World Health Organization showed that greater energy savings can be achieved by engaging the building occupants to reduce energy use (Treble, 2017).

Therefore, there is a need for further explanation in detail on how these strategies are implemented by describing the activities held, the types of rewards given, and etc. With a more detail explanation, it will aid the building managers in the hospital building to gain ideas on how they can emulate such practice into reality. The same strategy in a hospital building may not work effectively in another hospital building due to the different social-norm, and work culture.

2.2.8 Employees motivation towards electrical energy savings in hospitals

The review from the hospital building case studies above resulted to identification of 8 strategies used to encourage the staff to practice energy saving behavior. Moghimi *et al.*, (2015) revealed the following strategies adopted;

- **Posters, Label Stickers, and Banners to Save Energy:** NHS Hospital London designed a creative poster with persuasive interesting information on the benefits of saving electricity entitled Turn off machine, Lights out when not in use, Close doors when possible (TLC). The information stated in the poster is by educating the building occupants that making best use of the natural light can create a more relaxing environment where their recovery rates can be improved, sleeping patterns can be improved, and can help the room to be at a more comfortable temperature. Images on the poster illustrates persuasive information on why they should close doors and windows when possible and what coping mechanisms in response to thermal discomfort they can do without having to use additional energy use in the building. It informs the building users that personal adjustments such as wearing a thermal layer can help make you 1-2 degrees warmer, move around to keep your body warm and healthy by strengthening their muscles, and the importance of keeping the room at a comfortable range.
- **Create A Specific Team For Energy Saving Practice:** In UHNT consisting 11 hospitals, a committee called as the 'Green Team' are established with over 700 members. Within each building, the team members are segregated according to different departments or units. Each team is responsible for turning the lights off in designated areas. For example, a staff was assigned to ensure lights turned off in two meeting rooms near her office desk. A collective effort of these examples is able to save thousands of electricity costs over the years. Other terminology for

the committee is called as the ‘environmental committee’ in Cork University Hospital. The committee members meet up regularly and support each other when challenges are experienced.

- **Design periodical energy program on saving energy:** Temporary diverse programs are introduced within short period within the year. For example, a program on getting the staff to share their ideas on how to save energy was introduced in UHNT. The program was given a timeline with a deadline on submission of the idea via online. These suggestions were taken in the committee for review on its applicability. Another example of a program was called “Conservation Champion Reservation" which introduced was through a merit system. The staffs are given a recognition card for each energy saving behaviour performed. Collection of the recognition cards at a certain point permits the staff to redeem their reward. In this particular building a voucher worth USD25 was given. Other programs called as “Winner of Floor Challenge" was introduced in the hospital where different departments, units or floor levels competed between each other. However, not

i. **Lucky draw prizes**: Often when programmes are introduced, it will be paired with prizes as the main incentive for higher participation by the staff. By having incentives, research shows that naturally human behaviour will be more encouraged and motivated. Among the lucky draw prizes that were used was a VIP ticket to Vancouver Canadians baseball game. Understanding the culture of the country in selecting the incentive is vital to encourage participants. In Canada, baseball game receives significant popularity and interests across the nation. Research shows that different culture will require different incentives depending on the interests of the majority.

ii. **Organize a celebration event for energy savings achieved:** In a developed Healthcare system, not only individual recognition was given via prize but a collective recognition for the teams' effort are celebrated and announced in the organizations newsletter (Bin, 2012). A celebration on the energy savings achieved are celebrated by organizing a special event just on the occasion. Budget and time are given to staff by the management to organize the celebration event.

iii. **Distributed pens and t-shirt to remind employee on energy saving action:** Pens and t-shirts were given to staff to remind on the energy saving actions (Wells *et al.,* 2016). Giving additional items to promote energy efficiency initiatives can be argued to be not necessary since it will require additional expenses for the allowance of these items.

iv. **Open access websites on energy saving behaviour:** Newsletters on energy savings effort are regularly updated on the organization website in all of the hospital building case studies. Apart from the main organization website, other linked social media mediums are used such as Facebook, Instagram's, blogs, and twitter. The vitality of receiving updated news on achievements creates momentum on staffs' awareness level to revitalize their motivations in practicing energy saving behaviour. Research found that social media can play a significant positive impact to a social norm (Taneja & Toombs, 2014). Apart from news on energy savings achieved, archive documents on list of energy saving behaviours to perform, reports on the energy use of the buildings, feedback from the staff on the effectiveness of the strategies or initiatives implemented are all uploaded on the domain of the websites together with the other linked social media

v. **Energy efficiency survey feedback to the staff:** Feedbacks on each initiative implemented by UHNT are regularly collected. This information is vital in preparing a better strategy in the future. The systematic process demonstrated by

UHNT could be exemplified by other hospital building. Feedback surveys were not only collected via formal assessments such as from surveys, informal feedbacks from the regular meetings held are also documented for improvement in the future.

João and Justina (2016) assessed the motivation towards energy efficiency in small and medium enterprises. Industry is responsible for about 50% of world energy consumption and therefore for a big impact concerning greenhouse gas emissions and climate change. An important strategy to achieve the target of energy policies in Europe, of reducing the energy consumption by 20% by 2020, must consider reducing energy consumption in industry. When talking about industry, it must be remembered that small and medium-sized enterprises are a central part of economies worldwide, comprising 99% of enterprises and providing about 60% of employment. Increasing their energy efficiency represents considerable value for economies, societies and the enterprises themselves. Together with cost savings, energy efficiency can deliver other benefits that can help those companies grow and develop, for example by improving productivity, profitability and competitiveness and product quality. By reducing reliance on energy imports, and lowering environmental impacts, it increases value, not only to business, but also to society. Despite the benefits resulting from energy efficiency measures, their implementation in companies is not an easy task, due to existing barriers that must be identified in order to define motivation strategies that can fight those obstacles. A project, aiming to identify the situation in medium-sized enterprises and to provide them the necessary conditions to adopt energy efficiency improvements, was developed in Portugal. It enabled to conclude about best practices and technological solutions that answer the energy efficiency problems and to identify the main barriers that prevent that adoption, and measures that can contribute to overcome them. The research within the sectors studied showed that changing individual energy behaviors requires strategies that address both internal and external influences on behavior change and not simply new technologies, price incentives or information campaigns.

2.2.9 Refurbishment of hospital electrical energy appliances and devices

A serious debate on preventive maintenance (PM) intervals is taking place among clinical engineering (CE) practitioners on various levels and in professional journals. The debate is focused on the standard requirements by regulating authorities and accreditation organization in many countries that (PM) intervals should follow the equipment manufacturer's recommendations (Ridgway, 2009). Some devices that appear to be very similar in their function and design have manufacturer-recommended intervals that vary by a factor of two or more. The question has been raised about the credibility of these recommended intervals and whether it is based on meaningful test data. Debating the PM intervals with equipment manufacturers does not seem to be a practical approach because manufacturers may be reluctant to share that information with end-users if there are any documented data. Judging maintenance outcomes based on PM or safety and performance inspection (SPI) is not possible and the same applies to periodic replacement of parts or calibrations. Clinical and biomedical engineering professionals are still holding on to process measures rather than analyzing the outcome of refurbishment in spite of the experience from other industries, which shows that traditional PM is often unnecessary, if not counterproductive (Wang, 2017).

The Emergency Care Research Institute (ECRI) published a recommendation to use risk as the primary criteria for deciding which piece of equipment should be subject to SM as well as the frequency of the SM and risk was categorized as high-medium-low. ECRI has developed scheduled (planned) maintenance (SM) for most of medical equipment which is known as health device inspection and preventive refurbishment (IPM). This approach was known later as the risk-based inclusion criteria and allowed CE professionals to focus their PM on a limited portion of medical devices (life support). Ridgway (2009) noted that PM does have some impact on the reliability of some items and therefore it does have some beneficial impact on equipment uptime. However, the discussion about what value properly executed PM brings to the facility's refurbishment program requires considering the impact of eliminating or increasing the intervals for some or all of the PM-related tests and results achieved: increased safety, reduced downtime and fewer expensive repairs. Ridgway (Ridgway, 2008) further noted that PM is an issue of declining importance-relative to several other equipment issues. Yet, US$300 million per year is still allocated to this in the USA hospitals. Ridgway further indicated that there is still no good consensus on the definition of PM or even why it is done, no rational process for defining a non-critical device and no good method for justifying PM intervals. PM does not prevent all types of equipment failure and only addresses failures that result from the degeneration of a device's non-durable parts and hidden failure.

However, Zubair *et al*., (2016), assessed the safety and preventive maintenance of biomedical devices in Nigerian hospitals: a portable low cost electrical safety analyzer. The safety of biomedical devices in Nigerian hospitals is often neglected. Preventive maintenance schedules do not have a clear program for safety testing of various devices. Use of biomedical devices exposes patients, medical staff and visitors to electric hazards. Safety assurance of biomedical devices is critical. After repair or during preventive maintenance schedule, several electrical safety tests are carried out by a device called electrical safety analyzer (ESA) to ascertain the safety of medical equipment. Many hospitals in Nigeria do not have this device due to importation cost. The poor state of Nigeria economy imposes restriction on importation and favors indigenous development of goods and services. The design of a portable and affordable electrical safety analyzer is presented to improve safety of biomedical devices and healthcare delivery in Nigerian hospitals. The constructed electrical safety analyzer presents acceptable accuracy. The accuracy of the locally constructed electrical safety analyzer compared with an existing imported electrical safety analyzer is found to be approximately 2.22% which is within the tolerance limit specified by the United State Food and Drug Administration (FDA).

Moreover Firdaus *et al*., (2019) revealed that the maintenance for energy efficiency: a review. Energy efficiency program is used to reduce energy cost that leads to a reduction in production or overhead cost. Energy saving can be obtained by application of energy-efficient technologies, operational improvement, and effective maintenance. However, maintenance and energy efficiency is usually researched separately. The purpose of this paper is to investigate the role of maintenance in energy saving and available maintenance approaches for energy consumption reduction. Various literatures and publication on the research areas were reviewed and summarized to show the importance on maintenance and approached commonly used for energy efficiency.

Today, the refurbishment progress has been provoked by the increase in complexity in manufacturing processes and variety of products, growing awareness of the impact of refurbishment on the environment and safety of personnel, the profitability of the business and quality of products. There is a paradigm shift in implementing refurbishment strategies like condition-based maintenance (CBM) and reliability-centered maintenance (RCM). Then the risk-based maintenance (RBM) has been emphasized.

Classification and prioritization of medical devices for refurbishment activities

The ever-increasing number and complexity of medical devices demands that hospitals establish and regulate a Medical Equipment Management Program (MEMP) to ensure that critical devices are safe and reliable and that they operate at the required level of performance. As fundamental aspects of this program inspection, preventive maintenance, and testing of medical equipment should be reviewed continuously to keep up with today's technological improvements and the increasing expectations of healthcare organizations. No longer content to merely follow manufacturers' recommendations, hospital clinical engineering departments all around the world including Canada, Australia, and United States have begun to employ more efficient and cost-effective refurbishment strategies. Jamshidi *et al.*, (2010) have begun to develop a unique database to collect comparative data on inventory and refurbishment of the most critical devices used in hospitals across Canada and the United States. This project will provide a large statistical failure data set which could be used to establish optimum intervals for routine refurbishment scheduling. Ridgway (2009) provide concise guidelines for maintenance management of medical equipment and address methods, which have been used for a long time in other industry segments, such as RCM. Significant and critical assets should be identified and prioritized, and many techniques have been developed for criticality assessment of devices.

But Fennigkoh and Smith (2012) proposed a risk assessment method to group medical devices on the basis of their Equipment Management (EM) numbers, or the sum of the numbers assigned to the device's critical function, physical risk, and required maintenance: EM= Critical Function + Physical Risk + Required Maintenance. Devices with an EM number above a critical value 12 are considered to have critical risk and thus are included in inspection and refurbishment plans. JCAHO (2006) recognized importance of this method and eventually in 2004 approved it as the standard (EC6.10). This standard allows hospitals not to perform scheduled inspection or refurbishment tasks for certain pieces or types of medical equipment, if these tasks are not needed for safe and reliable operation (Wang, 2017).

Since then, Fennigkoh and Smith's method or its many variations have been used by clinical engineers (Rice *et al.*, 2007). Ridgway (2009) in his recent paper emphasizes that preventive maintenance can provide a benefit for just a relatively few devices, and a significant number of repair calls are made due to random failures of device's components. Wang and Rice (2003) propose simplified version of gradient risk sampling and attribute sampling to select a portion of equipment for inclusion. Clinical engineers believe that risk is not the only inclusion criterion, however, even though it is the most important one (Hyman, 2003). Other criteria which reflect the needs and reality of a hospital should be considered, including mission criticality, availability of backup, hazard notice, and recall history. Taghipour *et al.* (2012) presented a multi-criteria decision-making model to prioritize medical devices according to their criticality. Devices with lower criticality scores can be assigned a lower priority in a refurbishment management program. However, those with higher scores should be investigated in detail to find the reasons for their higher criticality, and appropriate actions, such as 'preventive refurbishment', 'user training', and 'redesigning the device should be taken.

2.3 Review of Related Empirical Studies

Albert *et al.*, (2015) carried out a research on a Comparative Analysis of Energy Usage and Energy Efficiency Behaviour In Low-and High-Income Households. This study was carried out in Kiktwe, Zambia, the key objective was to establish whether there was a difference in results between the inferential and descriptive statistics. Five other objectives were used for the study alongside the main objective. Methodologically, the study was largely quantitative in nature, with questionnaires administered to a combined total of 56 households. However, key interviews were also conducted that helped us to get a clearer understanding of some of the issues covered in the research. Key findings are that whereas the descriptive statistics show that there are behavioral differences between the two income groups, the inferential statistics show that there is no relationship between income level and the energy efficiency variables. This has been found to be consistent with results from studies done elsewhere. The key lesson is that there is low usage of energy efficiency measures in both low- and high-income areas and that the authorities need to change the way information is disseminated to consumers from the current method of advertising to social diffusion.

The above study is related to the present study because both studies are investigating issues related to electrical energy efficiency in hospitals. The present study differs in methodology and location. Where Albert *et al.,* study is carried out in Kiktwe, Zambia, the present study is carried out in Kogi, Nigeria. Also, the present study intends to use questionnaire only, Albert *et al.,* study used both questionnaire and interview as instrument for data collection.

Ali (2012) carried out a research on Electrical Energy Efficiency Improvement in Commercial Buildings: A Case Study of Selected Bank Buildings in Zaria. The study used energy audit to determine where, when, why and how electrical energy is being used in selected bank buildings in Zaria. The information was used to identify opportunities to improve efficiency, decrease energy cost and reduce greenhouse gas emissions that contribute to climate change. The study employed both primary and secondary sources of data. Questionnaires were the instruments of the primary data collection while information from manufacturers' manuals, catalogues and maintenance records of the banks constituted the secondary data. The findings indicated that the average electrical energy consumption and cost for the four (4) bank buildings are 7,412.26 kWh/month and N63,004 14/month before retrofitting. The actual energy consumed (estimated wattage Rating on nameplate of appliances/equipment) was also calculated and compared to the consumed energy using One-way ANOVA. It was concluded that energy usage in the bank buildings involved much wastage especially in the area of lighting, cooling and plug loads. An energy efficiency programme which covers lighting, cooling and the plug loads was recommended.

The above study is related to the present study because both studies discussed electrical energy efficiency, they tend to differ in the instruments for data collection where this study employed both the use of questionnaires and interview to collect data, the present study used questionnaire alone. This study was carried out on commercial buildings (banks) in Zaria while this was carried out in hospitals in Kogi State.

Saba *et al*., (2016) (a) conducted a research on Level of Electrical Energy Management Practice Awareness Among Residents in Niger State, Nigeria. The study investigated the level of electrical energy management practices awareness among residents in Niger State, Nigeria. The study adopted Cross Sectional Survey Research Design. The population of the study was made up of 191,416 heads of household in residential buildings that are connected to the distribution network in 25 Local Government Areas of Niger State. The sample of the study consisted of 1,290 heads of house hold in residential buildings, drawn through Multi-stage Sampling Techniques. Three research questions were formulated to guide the study. The instrument used for data collection was a structured questionnaire. Statistical Package for Social Sciences (SPSS Version 19) was used for data analysis. Mean and Standard Deviation were used to answer the research questions. The finding of the study shows that, residents in Niger State were somehow aware of electrical energy management practices in lighting, cooling and heating systems and the use of electric motors. Base on these findings, the following recommendations were made: Electricity Management Board in collaboration with Energy Commission of Nigeria and Center for Energy Efficiency and Conservation should jointly organize public enlightenment campaigns to promote awareness on electrical energy management practices in lighting, cooling and heating systems and the use of electric motors.

The above study is related to the present study because both studies discuss electrical energy savings/management, while this study is carried out in residential buildings the current study is carried out on hospitals. This study is carried out in Niger State with three objectives as well as generated research questions and hypotheses while the current study is carried out in Kogi State with five objectives as well as generated research questions and hypotheses. Cross Sectional Survey research design was used for this research while a descriptive survey research design will be used for the present study.

Saba *et al.,* (2016) (b) carried out a research on Behavioural Approaches to Electrical Energy Management in Residential Buildings in Niger State, Nigeria. The study adopted Cross Sectional Survey Research Design. The population of the study was made up of 191,416 heads of household in residential buildings that are connected to the distribution network in 25 Local Government Areas of Niger State. The sample of the study consisted of 1,290 heads of house hold in residential buildings, drawn through Multi-stage Sampling Techniques. Two research questions were formulated to guide the study. The instrument used for data collection was a structured questionnaire. Statistical Package for Social Sciences (SPSS Version 19) was used for data analysis. Mean and Standard Deviation were used to answer the research questions. The findings of the study shows that, consumers in Niger state rarely adopted the following human behavioural practices; utilization of low wattage lamp to provide required light, usage of appropriate colour for walls and ceilings for better illuminations, switching off light when not in used and they also practiced electrical load management habits at very high extent; ironing of cloth at the peak period and utilization of incandescent and halogen bulbs during peak period. It was recommended among others that; Policy and law makers with a sense of urgency should formulate policies and laws that will help in changing human behaviour and there should be more awareness on electrical load management habits among residents in order to cultivate positive practices towards energy usage during the peak period of electricity usage.

The above study is related to the present study because both studies discuss electrical energy savings/management, while this study is carried out in residential buildings the current study is carried out on hospitals. This study is carried out in Niger State with three objectives as well as generated research questions and hypotheses while the current study is carried out in Kogi State with five objectives as well as generated research questions and hypotheses. Cross Sectional Survey research design was used for this research while a descriptive survey research design will be used for the present study.

Maytham *et al.*, (2017) carried out a research on Awareness on Energy Management in Residential Buildings; A case study in Kajang and Putrajaya. Two research objectives were used, two research questions and two research hypotheses were used. A survey research was used in the research work. Questionnaires were developed with 37 questions grouped in 5 different sections related to home appliance information. Data was collected from a sample size of 384 respondents with confidence level of 95%. The accuracy of the percentage energy usage data were analysed by applying the SPSS software. Actual residential electric power consumption was measured by using a power quality analyzer to determine the total power consumption at weekday and weekend and power consumption of each electrical appliance. The measurement results showed that the average energy consumption is 25.8 kWh/day during weekend and 21.9 kWh/day during weekdays with 11.5 kWh/day for the air conditioner only. The survey results revealed that 89.06% of the respondents expressed awareness toward household power consumption and that they are willing to install home automation system to reducing their electricity bill.

Both studies, are related because they are both dealing with electrical energy management, though this study is carried on residential buildings while the current study is on hospitals. They also differ in research design, where this study used a survey research design, the present study will adopt a mixed method research design. Although the present study differs greatly in method of data collection and analysis. This study uses secondary data while the current study will use primary data. This study uses two research objectives while the current study used five research objectives.

Hammad, (2018) carried out a research on comparative study of energy consumption between various hospitals in Malaysia. The buildings' sector consumes about 15% of the total energy consumption in Malaysia. Of the biggest contributors to this figure are hospitals, which usually use energy above average due to their operation hours, occupants, and complex services. A survey study was conducted during various energy management system audits to Malaysian hospitals where important data for energy, load apportioning, and significant energy users are collected and comparatively analyzed. The data spans the period of three years from 2015 up till 2017 and the hospitals are categorized by their number of resident specialties and subspecialties. From the study, it was estimated that in 2015, district hospitals consume in average 2,237,776 kWh having a BEI of 148.92kWh/m2.year; minor specialist hospitals consume in average 6,155,092 kWh having a BEI of 216.62 kWh/m2.year; major specialist hospitals consume in average 17,848,413kWh having a BEI of 241.89 kWh/m2.year; general hospitals consume in average 28,224,856 kWh having a BEI of 240.96 kWh/m2.year. The load apportioning for 5 different hospitals were also analyzed and it was found that HVAC contributes to about 69% of the total load in hospitals. The study also found in 2016 that, the impacts of El Niño Southern Oscillation event to hospitals' energy consumption increased the energy consumption up to 13.6% depending on the types of hospitals. The study concluded with ways that could improve energy performance in hospitals from various angles that include technical, management and system improvement.

Both studies are analysis of electrical energy and are both survey researches. This study was carried out in Malaysia with three main objectives, while the present study was carried out in Kogi State with five objectives. While this study was about energy consumption the present study is about energy savings.

Oyeleke (2018) carried out a research on Comparative Analysis of Household Energy Consumption in Ibadan Region; A Spatio-quantitative Approach. Understanding locational variations in household energy consumption is critical to ascertaining dichotomies of energy use, need and wellbeing. In recognition of this, the study compares quantities of household energy consumption among urban, peri-urban and rural areas in Ibadan region, Nigeria using Net Heating Value (NHV). It employs a stratified random sampling of 166 households across the three zones. Results show that electricity, majorly used for appliances is dominant in the urban in contrast to fuel wood at the peri-urban and rural areas where cooking is the major end use. Though the quantities of total household energy consumption do not vary significantly at $p < .05$, electricity consumption is however significantly higher in urban households than in peri-urban and rural households. The Multiple Regression Analysis (MRA) and Analysis of Variance (ANOVA) indicate that socioeconomic characteristics significantly influenced quantity of household energy consumption at the urban area only. Major variations between locations appear to be in energy types and end uses rather than quantity consumed.

Both studies are comparative analysis of electrical energy and are as well both survey researches. They differ in sampling techniques, where this study used random sampling technique, disproportionate sampling would be adopted in the current study. Both study adopts same method of data analysis which is ANOVA,.

Ling *et al.,* (2020) carried out a research on Rural Household Energy Consumption Investigation and Structural pattern Analysis of Xuanwei study area in Central Yunnam. Rural household energy utilization is an important consumption that related to the survival and development of regional rural residents. With the deepening of the strategy of poverty alleviation and rural revitalization in China, the problem of energy consumption in rural households has become the focus of attention. In this paper, Xuanwei County, which is typical representative in Central Yunnan, is selected as the research case. Through the field investigation and questionnaire survey, the energy consumption status and structure pattern of rural households in the mountainous areas of the Central Yunnan Plateau are analysed and studied by using the methods of statistical perspective analysis and data induction and sort out. The main results are as follows: 1) In Central Yunnan, the current situation of rural household energy consumption is belong to the "electricity+" hybrid basic structure pattern, which is mainly based on electricity and combined with coal, fuel-wood, straw and so on to be of the diversified structure energy consumption characteristic. 2) Though there are 13 kinds of rural household energy consumption hybrid patterns in the study area, but only six kinds is found belong to dominant hybrid energy utilization structure patterns, namely, "electric-coal-firewood", "electric-firewood-straw" and "electric-coal-straw", "electric-firewood" and "electric-coal", as well as "single electricity" utilization type of energy mixed mode. In general, through the rural household energy investigation analysis is only completed in Xuanwei case, the general characteristics and its structural pattern in Central Yunnan can been obtained in the same thing. So the results will be helpful to guide the formulation of rural energy policy and management optimal utilization of regional rural energy in Central Yunnan and promote the implementation of National Rural Revitalization and Precision Poverty Alleviation Strategy.

The above study is related to the present study because both studies are research on energy consumptions and savings in hospitals and are both survey research. Hence they have differences in the methodology and area of study, where this study used investigation and questionnaire for the survey and was carried out in Central Yunnan, the present study used descriptive survey and was carried out in Kogi State.

2.4 Summary of Literature Review

Literature was reviewed under the following sub-headings; theoretical framework, conceptual framework and empirical studies. Relevant theories related to this study were reviewed under theoretical framework such as theory of reasoned action and the theory of planned behavior (TPB).

The theory of planned behavior (TPB), which was an extension of the theory of reasoned action (TRA), reveals that there exists a complicated psychological process behind the individual behavior. The behavior is the results of a series of mental processes. The actual behavior is decided by behavior intention, and the behavior intention is affected by the attitude, subjective norms and perceived behavioral control.

Under conceptual framework, the concept of general hospital, energy efficiency in hospitals, electrical energy consuming devices in hospitals and efficiency, hospital maintenance practices, electrical energy usage/consumption in hospitals, electrical energy saving approaches in hospitals, attitudes and behavior of hospital staff towards electrical energy efficiency, employees motivation towards electrical energy savings in hospitals, refurbishment of hospital electrical energy appliances and device, classification and prioritization of medical devices for refurbishment activities, were reviewed and under the empirical studies, closely related studies were also reviewed. The finding from the studies reviewed, shows that the main motivation of electrical energy efficiency is often simply saving money by lowering the cost of purchasing energy. Additionally, from an electrical energy policy point of view, there has been a long trend in a wider recognition of electrical energy efficiency as the "first fuel", meaning the ability to replace or avoid the consumption of actual fuels. In fact, International Energy Agency has calculated that the application of energy efficiency measures in the years 1974-2010 has succeeded in avoiding more energy consumption in its member states than is the consumption of any particular fuel, including oil, coal and natural gas.

Despite several works of literature that suggest that there may be poorly energy saving management in household, residential and commercial buildings, it is not poorly developed equipment/devices and appliances alone that causes difficulties with energy savings in general hospitals. Rather, difficulties arise in saving electrical energy in most general hospital as a result of the staff attitudes, maintenance practices and motivations. Furthermore, this study bridges the gap because it is the first study to discuss energy savings in general hospitals in kogi state.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Research Design

A descriptive survey research design was adopted. According to Nworgu (2018) survey research is a kind of research in which a group of people or items are studied by collecting and analyzing data from the target group. Therefore a descriptive survey research design was adopted to describe the research questions and the similarities among variables. Quantitative data was obtained from this research design which involves the use of questionnaire to seek information from staff on the issue of electrical energy saving approaches adopted in general hospitals in Kogi state. This research design is suitable for this research since it enabled the researcher to gather broader data that provided a more comprehensive explanation of the energy efficiency in general hospital.

3.2 Area of the Study

This study was carried out in Kogi State in the central region (Middle-Belt) of Nigeria. It is popularly called the Confluence State because of the confluence of River Niger and River Benue at its capital, Lokoja, which is the first administrative capital of modern-day Nigeria. The state was created in 1991 from parts of Kwara State and Benue State. Kogi State has a total land area of 27,747km^2 and a population of 4,750,115 (Britannica, 2020). Kogi lies approximately along latitude 7^0N and 6^0E and is bordered by the states of Nassarawa to the Northeast; Benue to the east; Enugu, Anambra, and Delta to the south; Ondo, Ekiti, and Kwara to the west; and Abuja Federal Capital Territory and Niger to the north.

Kogi State was chosen for this study because of the lingering power problem in the state. The state has not adopted enough measures to address this problem, as such it is pertinent to start with one of the most consumers of energy-hospital.

3.3 Population of the Study

The population of the study consisted of all the staff of the general hospitals in Kogi state. Data from the Ministry of Health in Kogi State showed that there are 64 Doctors, 544 Nurses and Nurse Aides, 34 Electrical Technicians and 30 Laundry Staff in the General Hospitals in Kogi State. This brought the expected population from the general hospitals to 672 staff.

Table 3.1: Population of the study

Staff	**Population**
Doctors	64
Nurses	450
Nurse Aides	94
Electrical Tehnicians	34
Laundry Staff	30
Total	672

Source: Ministry of Health Kogi state (2021)

3.4 Sample and Sampling Techniques

A sample of 201 respondents made up of 26 Doctors, 135 Nurses, 20 Nurse Aides, 9 Electrical Technicians and 11 Laundry staff from the various sampled general hospitals were used for the study. Multi-stage sampling technique was adopted in selecting the sample size. Through disproportionate stratified random sampling technique, three General Hospitals were selected from each senatorial district of the State. From each of the three selected General Hospitals, the group of staff was purposively selected based on the researcher's perceived importance of their dispositions towards responding to the questionnaire items: Doctors, Nurses and Nurse Aides, Electrical Technicians and Laundry Staff. Table 3.1 revealed the respondents from sampled General Hospitals.

Table 3.2: Distribution of population sample from the Three Sampled Hospitals

Location	Doctors	Nurses	Nurse Aides	Electrical Technicians	Laundry Staff
Kabba	6	40	5	2	3
Lokoja	12	50	9	4	5
Okene	8	45	6	3	3
Total 201	**26**	**135**	**20**	**9**	**11**

3.5 Instrument for Data Collection

The Instrument for data collection was a well-structured questionnaire developed by the researcher titled "Electrical Energy Saving Approaches Adopted in General Hospitals" (EESAAGH). EESAAGH was divided into two sections, A and B. Section A was used to gather information on the personal data of the respondents. Section B contains 90 questionnaire items that were further divided into five sub- sections in line with the research questions. The sub-section elicited responses regarding: The electrical energy efficiency appliances and devices used in General Hospitals, the maintenance practices adopted for efficient electrical energy savings in General Hospitals, the attitude of hospital staff towards electrical energy savings in General Hospitals, the electrical energy appliances and devices refurbished in General Hospitals and the staff motivations towards electrical energy savings in General Hospitals. The instrument was a four-point rating scale of Very Highly Used (VHU=4), Highly Used (HU=3), Rarely Used (RU=2) and Not Used (NU=1) for research question 1.Very Highly Adopted (VHA=4), Highly

Adopted (HA=3), Rarely Adopted (RA=2) and Not Adopted (NA=1) for research question 2. Research Question 3 and 5 will use a four-point rating scale of Strongly Agreed (SA=4), Agreed (A=3), Disagreed (D=2) and Strongly Disagreed (SD=1).While research question 4 will use a four-point rating scale of More Recent (MR=4), Recent (R=3), Less Recent (LR=2) and Not Recent (NR=1).

3.6 Validation of the Instrument

Copies of the drafted instruments were subjected to content validity by two experts from Electrical/Electronic Technology option in the Department of Industrial and Technology Education, Federal University of Technology, Minna, Niger State and one expert from the Department of Electrical and Electronics Engineering, Federal University of Technology, Minna, Niger State. These experts were requested to add or remove any item, suggest modifications to the structure of the items, organization and assess appropriateness according to their suitability for the research questions of the study. After validation, all corrections like reducing the number of items from 107 to 90, merging two or more similar items and using a straight forward term for the items were effected.

3.7 Reliability of the Instrument

A pilot study was conducted using 15 staff of General Hospital Minna, Niger State (12 Nurses and 3 Electrical Technicians). Questionnaires were administered to the staff of the hospital through the help of a research assistant and the questionnaires collected was analyzed using Cronbach's Alpha method to check the reliability and internal consistency of the instrument. The result of the reliability coefficient was given for clusters A: 0.85, B: 0.76, C: 0.78, D: 0.81 and E: 0.80 respectively. An overall reliability coefficient of 0.80 was obtained which was very high and therefore considered acceptable for the study (see appendix C).

3.8 Administration of the Instrument

The questionnaire were administered to the respondents by the researcher with the aide of three (3) research assistants. Each was be briefed verbally by the researcher on how to administer the instrument so as to ensure safe handling and return of the instrument. The questionnaires were administered simultaneously to the three hospitals and was retrieved at the interval of a week to enable the respondents have enough time to respond well. A total number of 201 questionnaires was administered to the three sampled General Hospitals and 191 questionnaires was retrieved by the end of the exercise. This was 95% of the actual instrument initially distributed.

3.9 Method of Data Analysis

The data analysis for this study was carried out using Statistical Package for Social Science (SPSS) 23 to enhance speed and accuracy of the analysis. The statistical tools used in this study are Mean, Standard Deviation and Analysis of variance (ANOVA) statistics. The mean and standard deviation was used to answer the research questions while ANOVA was used to test null hypotheses at 0.05 level of significance. Levene's test of homogeinity was carried out to check the level of similarities between the variables. The null hypotheses with p-values lower than 0.05 were rejected while those with p-values greater than 0.05 were accepted. A post-hoc test was carried out for null hypothesis that was significant. The standard deviation was used to decide the closeness or otherwise of the respondents from their mean responses. Therefore, any item with a standard deviation of less than 1.96 was indicated that respondents has close range of disparity in their responses; and any item having standard deviation equal or above the critical standard deviation was revealed that here was far range of disparity between their mean responses.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSIONS

4.1 Research Question One

How are the electrical energy efficiency appliances and devices used in General Hospitals in Kogi State?

The results of respondents on electrical energy efficiency applainces and devices used in General Hospitals in Kogi State is presented in Table 4.1.

Table 4.1: Mean and standard deviation on electrical energy efficiency appliances and devices used in General Hospitals in Kogi State.

N=9

S/N	ITEMS	Mean	SD	Rmks
1.	Tier 2 advanced power strip	2.44	0.62	RU
2.	Smart energy meters (SMET 2)	2.47	0.60	RU
3.	Modern Socket Outlet	2.28	0.21	RU
4.	LED bulbs	3.44	0.62	HU
5.	Smartthermostats(Google Nest thermostat)	2.28	0.43	RU
6.	Leak sensor	2.28	0.39	RU
7.	Motion sensor lighting control	1.64	0.60	RU
8.	Continous-flow Anaesthetic machines	1.72	0.39	RU
9.	Light dimmers	1.39	0.39	RU
10.	Lighting thermal control	1.64	0.60	RU
11.	Surgical lights	3.28	0.39	HU
12.	Dry heat sterilizer	3.28	0.39	HU
13.	Portable electric space heater	1.72	0.43	RU
14.	Philips clear vue 550 ultrasound	1.72	0.39	RU
15.	KUB X-ray machine	3.11	0.47	HU
16.	Rechargeable DC fan	1.72	0.39	RU
17.	Halogen lamp (~15–20 lm/W)	1.81	0.36	RU
18.	Small waste autoclave	1.64	0.60	RU
19.	Split air conditioner	3.03	0.60	HU
	GRAND MEAN	**2.26**		**Rarely Used**

Keys: Mean:- Average mean responses of technicians in the 3 General Hospitals, N:- Number of respondents, SD:- Standard Deviation, Rmks:- Remarks, RU:- Rarely Used HU:- Highly Used.

Table 4.1 show the analysis of the responses of technicians from General Hospital Kabba, Lokoja and Okene on electrical energy efficiency appliances and devices used in General Hospitals in Kogi State. The Table reveals that 14 items with means ranging from 1.64 to

2.28 were rarely used while 5 items which are 4, 11, 12, 15, and 19 with means ranging from 3.03 to 3.44 were highly used. Hence efficient electrical energy appliances and devices are rarely used and there is close disparity in the response of the respondents.

4.2 Research Question Two

What are the maintenances practices adopted for efficient electrical energy saving in general hospitals in Kogi State?

The results of respondents on the maintenance practices adopted for efficient electrical energy saving in General Hospitals in Kogi State is presented in Table 4.2.

Table 4.2: Mean and standard deviation on the maintenances practices adopted for efficient electrical energy saving in General Hospitals in Kogi State.
N=191

S/N	ITEMS	Mean	SD	Rmks
1.	Change light bulbs to LED	3.16	0.68	HA
2.	Air seal cracks, gaps, leaks and add insulator to maintain heating and cooling	2.16	0.48	RA
3.	Clean or replace air filters of the AC in the hospital	3.22	0.57	HA
4.	Lubricating of fans for efficiency	1.45	0.51	NA
5.	Install a programmable thermostat that will automatically adjust temperature according to schedule	1.67	0.57	RA
6.	Cleaning of luminaries	1.44	0.51	NA
7.	Avoid placing appliances that give off heat, such as lamps or TVs near a thermostat	1.58	0.57	RA
8.	Refrigerator temperature is set to the manufacturer's recommendation	1.59	0.50	RA
9.	X-ray machines, films processors and other machines are switched off when not required	3.08	0.66	HA
10.	Regular cleaning of fans	1.42	0.58	NA
11.	Regular Housekeeping	1.75	0.43	RA
12.	Identification of (potential) energy loss is usually part of an energy audit	1.20	0.44	NA
13.	Visual inspection during walk-through audit to identify energy wasted in the facility	1.29	0.41	NA
14.	Lighting energy audit is performed to evaluate the lighting system in a facility	1.29	0.47	NA
15.	Purchasing high efficiency motor instead of rewinding burnt coil	1.73	0.44	RA
16.	Improving lighting control	1.48	0.51	NA
17.	Proper positioning of refrigerator	3.06	0.55	HA
18.	Regular adoption of visualized tools for monitoring energy consumption	1.24	0.42	NA

Continuation of Table 4.2

19.	Predictive maintenance in general hospitals	1.33	0.47	NA
20.	Preventive maintenance in general hospitals	1.16	0.34	NA
21.	Corrective maintenance in general hospitals	3.24	0.52	HA
	GRAND MEAN	**1.88**		**RA**

Keys: Mean:- Average mean responses of staff in the 3 General Hospitals, N:- Number of respondents, SD:- Standard Deviation, Rmks:- Remarks, NA:- Not Adopted, RA:- Rarely Adopted, HA:- Highly Adopted.

Table 4.2 show the analysis of responses on maintenances practices adopted for efficient electrical energy saving in General Hospitals in Kogi State. From the responses, it can be seen that; 3 items such as 1, 3, 9, 17 and 21 are Highly Adopted, items such as 2, 5, 7, 8, 11 and 15, are Rarely Adopted while the rest of the items, 4, 6, 10, 12, 13, 14, 16, 18, 19 and 20 are Not Adopted. This therefore shows that most maintenance practices are not regularly carried out in General Hospitals in Kogi State and there is close disparity in the response of the respondents.

4.3 Research Question Three

What are the Attitudes of hospital staff towards electrical energy savings in general hospitals in Kogi, State?

The result of respondents is presented in Table 4.3 below;

Table 4.3: Mean and standard deviation on attitudes of hospital staff towards electrical energy savings in general hospitals in Kogi State.

N=191

S/N	**ITEMS**	**Mean**	**SD**	**Rmks**
1.	I take electrical energy saving practices very important	3.14	0.44	A
2.	Electrical energy efficiency is the major decision making factor for me when buying appliances/devices	3.06	0.42	A
3.	I will rather use the natural sunlight during the day than put on the electric light	1.84	0.61	D
4.	I turn on computers and machines only when they are needed	3.30	0.53	A
5.	I turn off the electric oven a few minutes before cooking time runs out	1.86	0.70	D
6.	Closing the blinds, shades on the sunny side of the rooms to help keep the room temperature cooler and reduce the work of the AC during summer	3.19	0.46	A
7.	During rainy seasons, I open shades to let the sun warm the rooms and reduce the work of the heater during cold season	3.20	0.51	A

Continuation of Table 4.3

8.	I will rather turn off the lights when they are not in use	3.23	0.47	A
9.	I prefer to replace old appliances with more energy efficient ones	3.26	0.55	A
10.	I rather set refrigerator temperature to the manufacturer's recommendation to avoid excessive cooling and wasting of energy	3.36	0.48	A
11.	Electrical energy saving policy of the organization is well understood and strictly adhered to by me	2.90	0.53	A
12.	I do not leave machines and equipment's plugged in overnight when not needed	3.28	0.45	A
13.	I close my doors and windows when AC is put on	3.56	0.50	SA
14.	All staff are zealous about electrical energy savings	2.41	0.50	D
15.	I see electrical energy saving practices as extra work load	2.86	0.32	A
	GRAND MEAN	**2.96**		**Agree**

Keys: Mean:- Average mean responses of staff in the 3 General Hospitals, N:- Number of respondents, SD:- Standard Deviation, Rmks:- Remarks, D:- Disaggree, A:- Agree, SA:- Strongly Agree.

Table 4.3 represent the analysed data from the respondents on the attitudes of hospital staff towards electrical energy savings in general hospitals in Kogi, State. The respondents strongly agreed to item 13 with a mean rating of 3.56. Item 1,2,4,6,7,9,10,11,12, and 15 were all agreed to with means ranging from 2.41 to 3.36 while items 3,5 and 14 with means ranging from 2.41 to 1.84 were disagreed. This shows that the attitudes of the staff towards energy efficiency is good and there is close disparity in the response of the respondents.

4.4 Research Question Four

How recent are electrical energy appliances and devices refurbished in general hospitals in Kogi State?

The results of respondents is presented in Table 4.4 below;

Table 4.4: Mean and standard deviation on how recent electrical energy appliances and devices are refurbished in general hospitals in Kogi State.

N=9

S/N	ITEMS	Mean	Standard Deviation	Remarks
1.	Power strip	3.78	0.85	More Recent
2.	Smart energy meters	3.81	0.96	More Recent
3.	Smart outlets	3.78	0.97	More Recent
4.	LED bulbs	3.78	0.83	More Recent
5.	Smart thermostats	3.61	0.39	More Recent
6.	Home energy monitor	3.39	0.19	Recent
7.	Oven and cloth washers	3.19	0.36	Recent
8.	Anaesthesia machines	3.11	0.19	Recent
9.	Electrocardiogram EKG machines	3.22	0.19	Recent
10.	Surgical lights	3.78	0.19	More Recent
11.	Fans	3.72	0.43	More Recent
12.	Refrigerators	3.53	0.36	More Recent
13.	Dry heat sterilizer	3.89	0.19	More Recent
14.	Electric space heater	3.78	0.19	More Recent
15.	Pulse oximeter	3.08	0.17	Recent
16.	Vacuum aspirator	3.78	0.19	More Recent
17.	Ultrasound	3.19	0.36	Recent
18.	Centrifuge	3.19	0.36	Recent
19.	X-ray machine	3.19	0.19	Recent
20.	Laboratory incubator	3.28	0.39	Recent
21.	GeneXpert MTB/RIF diagnostic	3.22	0.19	Recent
22.	Electrocardiograph (ECG)	3.17	0.19	Recent
23.	Oxygen concentrator	4.00	0.00	More Recent
24.	Split air conditioner	3.39	0.39	Recent
	GRAND MEAN	**3.49**		**Recent**

Keys: Mean:- Average mean responses of technicians in the 3 General Hospitals, N:- Number of respondents, SD:- Standard Deviation, Rmks:- Remarks.

From Table 4.4; it show that items 1, 2, 3, 4, 5, 10, 11, 12, 13, 14, 16, and 23 with means ranging from 3.53 to 4.00 are refurbished more recent while 6, 7, 8, 9, 15, 17, 18, 19, 20, 21, 22, and 24 with means ranging from 3.11 to 3.39 are refurbished recent. Hence with rating of the grand mean and standard deviation, appliances and devices are refurbished recently in General Hospitals in Kogi State and there is close disparity in the response of the respondents.

4.5 Research Question Five

How are staff motivated towards electrical energy savings in general hospitals in Kogi State?

The results of respondents is presented in Table 4.5 below;

Table 4.5: Mean and standard deviation on ways staff are motivated towards electrical energy savings in general hospitals in Kogi State.

N=191

S/N	ITEMS	Mean	Std	Rmks
1.	Use of posters, labels stickers, and banners.	1.31	0.46	SD
2.	Creating a specific team for electrical energy saving practices.	1.45	0.55	SD
3.	Designing a periodical electrical energy programme on saving energy.	1.23	0.40	SD
4.	Use of open access websites on electrical energy saving behavior	1.40	0.47	SD
5.	Incentives for staff actively carrying out electrical energy saving measures.	1.39	0.46	SD
6.	Organizing online classes for staff on electrical energy savings.	1.41	0.49	SD
7.	Friendly competitions among departments with subsequent rewards on electrical energy savings.	1.39	0.40	SD
8.	Regular education on electrical energy savings.	1.32	0.47	SD
9.	Regular statistics of electrical energy usage.	1.32	0.44	SD
10.	Publication of amount paid for electrical energy usage.	1.42	0.50	SD
11.	Distributing pens and t-shirt to remind employee on electrical energy saving action	1.38	0.47	SD
	GRAND MEAN	**1.37**		**SD**

Keys: Mean:- Average mean responses of staff in the 3 General Hospitals, N:- Number of respondents, Rmks:- Remarks, SD:- Strongly Disagree Std:- Standard Deviation.

Table 4.5 present how staff are motivated towards electrical energy savings in general hospitals in Kogi, State. From the analysis of the respondents, all the items with means range of 1.23 to 1.45 strongly disagreed on ways staff are motivated. This shows that the staff are not motivated towards energy savings in General Hospitals in Kogi State and there is close disparity in the response of the respondents.

4.6 Hypotheses Testing

4.6.1 Hypotheses One

H_{O1}: There is no significance difference among the mean responses of staff on the electrical energy efficiency appliances and devices used in General Hospitals in Kogi State.

The result for Levene's test of homogeneity and hypothesis one is presented in Table 4.6

Table 4.6: Analysis of variance statistics of the mean responses of staff on the electrical energy efficiency appliances and devices used in General Hospitals in Kogi State.

	Sum of Squares	*df*	Mean Square	Levene Statistic	Levene Sig.	F	Sig.	Decision
Between Groups	6.722	2	3.361	2.199	0.192	0.205	0.820	Not Significant
Within Groups	98.167	6	16.361					
Total	104.889	8						

The result presented in Table 4.6 revealed that the grand mean of Kabba, Lokoja and Okene technicians on the electrical energy efficiency appliances and devices used in General Hospitals in Kogi State were 2.18, 2.29 and 2.30 respectively, the levene significance shows that the test for homogeneity is not significant hence led to the use of ANOVA statistics for the hypotheses test. The ANOVA test value of 0.82 is greater than 0.05. This suggest that there was no significant difference in the mean responses of Kabba, Lokoja and Okene technicians on the electrical energy efficiency appliances and devices used in General Hospitals in Kogi State. As a result, the null hypothesis was accepted.

4.6.2 Hypotheses Two

H_{O2}: There is no significance difference among the mean responses of staff on the maintenance practices adopted for efficient electrical energy saving in General Hospitals in Kogi State.

The result for Levene's test of homogeneity and hypothesis one is presented in Table 4.7

Table 4.7: Analysis of variance statistics of the mean response of staff on the maintenances practices adopted for efficient electrical energy saving in General Hospitals in Kogi State.

	Sum of Squares	*df*	Mean Square	Levene Statistic	Levene Sig.	F	Sig.	Decision
Between Groups	9.652	2	4.826	5.350	0.05	0.623	0.537	Not Significant
Within Groups	1455.406	188	7.742					
Total	1465.058	190						

The result presented in Table 4.7 revealed that the grand mean of Kabba, Lokoja and Okene staff on the maintenance practices adopted for efficient electrical energy saving in General Hospitals in Kogi State were 1.88, 1.90 and 1.87 respectively, the levene significance shows that the test for homogeneity is not significant hence led to the use of ANOVA statistics for the hypotheses test. The ANOVA test value of 0.54 is greater than 0.05. This suggest that there was no significant difference in the mean responses of Kabba, Lokoja and Okene staff on the maintenance practices adopted for efficient electrical energy saving in General Hospitals in Kogi State. As a result, the null hypothesis was accepted.

4.6.3 Hypotheses Three

Ho3: There is no significance difference among the mean responses of staff on the attitudes towards electrical energy saving in General Hospitals in Kogi State.

The result for Levene's test of homogeneity and hypothesis one is presented in Table 4.8

Table 4.8: Analysis of variance statistics of the mean responses of staff on attitudes of hospital staff towards electrical energy savings in General Hospitals in Kogi State.

	Sum of Squares	*df*	Mean Square	Levene Statistic	Levene Sig.	F	Sig.	Decision
Between Groups	3.091	2	1.546	0.514	0.599	0.311	0.733	Not Significant
Within Groups	934.375	188	4.970					
Total	937.466	190						

The result presented in Table 4.8 revealed that the grand mean of Kabba, Lokoja and Okene staff on the attitudes of hospital staff towards electrical energy savings in General Hospitals in Kogi State were 2.86, 2.85 and 2.87 respectively, the levene significance shows that the test for homogeneity is not significant hence led to the use of ANOVA statistics for the hypotheses test. The ANOVA test value of 0.73 is greater than 0.05. This suggest that there was no significant difference in the mean responses of Kabba, Lokoja and Okene staff on the attitudes of hospital staff towards electrical energy savings in General Hospitals in Kogi State. As a result, the null hypothesis was accepted.

4.6.4 Hypotheses Four

H_{o4}: There is no significance difference among the mean responses of staff on the electrical energy appliances and devices refurbished in General Hospitals in Kogi State.

The result for Levene's test of homogeneity and hypothesis one is presented in Table 4.9

Table 4.9: Analysis of variance statistics of the mean responses of staff on how long are electrical energy appliances and devices refurbished in General Hospitals in Kogi State.

	Sum of Squares	*df*	Mean Square	Levene Statistic	Levene Sig.	F	Sig.	Decision
Between Groups	24.139	2	12.069	0.132	0.879	4.323	0.069	Not Significant
Within Groups	16.750	6	2.792					
Total	40.889	8						

The result presented in Table 4.9 revealed that the grand mean of Kabba, Lokoja and Okene technicians on the electrical energy appliances and devices refurbished in General Hospitals in Kogi State were 3.50, 3.55 and 3.43 respectively, the levene significance shows that the test for homogeneity is not significant hence led to the use of ANOVA statistics for the hypotheses test. The ANOVA test value of 0.069 is greater than 0.05. This suggest that there was no significant difference in the mean responses of Kabba, Lokoja and Okene technicians on the electrical energy appliances and devices refurbished in General Hospitals in Kogi State. As a result, the null hypothesis was accepted.

4.6.5 Hypotheses Five

H_{o5}: There is significance difference among the mean response of staff on the motivations towards electrical energy saving in General Hospitals in Kogi State.

The result for Levene's test of homogeneity and hypothesis one is presented in Table 4.10

Table 4.10: Analysis of variance statistics of the mean responses of staff on how staff are motivated towards electrical energy savings in General Hospitals in Kogi State.

	Sum of Squares	*df*	Mean Square	Levene Statistic	Levene Sig.	F	Sig.	Decision
Between Groups	73.707	2	36.853	0.837	0.435	17.255	0.000	Significant
Within Groups	401.539	188	2.136					
Total	475.246	190						

The result presented in Table 4.10 revealed that the grand mean of Kabba, Lokoja and Okene staff on the ways staff are motivated towards electrical energy savings in General Hospitals in Kogi State were 1.43, 1.29 and 1.38 respectively, the levene significance shows that the test for homogeneity is not significant hence led to the use of ANOVA statistics for the hypotheses test. The ANOVA test value of 0.00 is less than 0.05. This suggest that there was significant difference in the mean responses of Kabba, Lokoja and Okene staff on ways they are motivated towards electrical energy savings in General Hospitals in Kogi State. As a result, the null hypothesis was rejected, however a post-hoc comparison test was carried out.

Table 4.11: Post-hoc comparisons using Tukey HSD test on the difference on how staff are motivated towards electrical energy savings in General Hospitals in Kogi State.

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Interval Lower Bound	Confidence Upper Bound
GHK	GHL	1.49037*	.26083	.000	.8742	2.1066
	GHO	.55854	.27203	.103	-.0841	1.2012
GHL	GHK	-1.49037*	.26083	.000	-2.1066	-.8742
	GHO	-.93183*	.25085	.001	-1.5244	-.3392
GHO	GHK	-.55854	.27203	.103	-1.2012	.0841
	GHL	.93183*	.25085	.001	.3392	1.5244

*. The mean difference is significant at the 0.05 level.

Keys: GHK:- General Hospital Kabba, GHL:- General Hospital Lokja, GHL:- General Hospital Okene.

Table 4.11 shows the result of Post-hoc comparisons using the Tukey HSD test on how staff are motivated towards electrical energy savings in General Hospitals in Kogi State**.** The results indicated that the mean response for General Hospital Kabba (whose means difference was -1.49037 with sig of 0.000) was significantly different from the mean response for General Hospital Lokoja (whose mean difference was 0.93183 with significance of 0.001). Which also differ significantly for General Hospital Okene (whose mean difference was 0.55854, and a significance criterion (sig) of 0.103).

4.7 Findings of the Study

The findings of the study were based on the data collected and analyzed with reference to the research questions and hypotheses that guided the study. The following findings emerged from the study:

a. The study revealed that staff rarely use efficient electrical energy appliances and devices in General Hospitals in Kogi State.

b. Findings on the maintenance practices adopted for efficient electrical energy savings revealed that staff rarely adopt good maintenance practices for efficient electrical energy savings in General Hospitals in Kogi State.

c. The findings on the attitudes of hospital staff towards electrical energy savings revealed that the staff agreed with the attitudes hence, takes electrical energy saving practices very important, turn on computers and machines only when they are needed, mention but a few to save electrical energy.

d. Findings on the electrical energy appliances and devices refurbished revealed that appliances and devices in General Hospitals in Kogi State are recently refurbished.

e. The study revealed that staff motivation towards electrical energy savings through all the items such as use of posters, labels stickers and banners, creating specific team for electrical energy saving practices, incentives for staff actively carrying out electrical energy saving measures and a few more are strongly disagreed. There is no motivation towards staff on electrical energy savings in General Hospitals in Kogi State.

f. There is no significance difference among the mean responses of staff on the electrical energy efficiency appliances and devices used in General Hospitals in Kogi State.

g. There is no significance difference among the mean responses of staff on the maintenance practices adopted for efficient electrical energy saving in in General Hospitals in Kogi State.

h. There is no significance difference among the mean responses of staff on the attitudes towards electrical energy saving in General Hospitals in Kogi State.

i. There is no significance difference among the mean responses of staff on the electrical energy appliances and devices refurbished in General Hospitals in Kogi State.

j. There is significance difference among the mean responses of staff on the motivations towards electrical energy saving in General Hospitals in Kogi State.

4.8 Discussion of Findings

The findings in Table 4.1 relating to research question 1 showed that respondents agreed with 5 out of the 19 items on the electrical energy efficiency appliances and devices used in General Hospitals in Kogi State. The finding showed that LED bulbs, Surgical lights, Dry heat sterilizer, KUB X-ray machine and Split air conditioner are the electrical energy efficiency appliances and devices Highly Used. This is in conformity with the views of Matsushima *et al.,* (2010) who asserted to the use of light emitting diode (LED) lighting in hospitals and its contribution to energy efficiency. Corroborating with this finding Diesendorf, (2019) points out that installing LED lighting, fluorescent lighting, or natural skylight windows reduces the amount of energy required to attain the same level of illumination compared to using traditional incandescent light bulbs. Improvements in energy efficiency are generally achieved by adopting a more efficient technology or production process by application of commonly accepted methods to reduce energy losses.

However, ANOVA statistic test was used to test the null hypothesis at 0.05 significant level as seen in Table 4.6. The findings revealed that the p-values [Significance (2-tailed)] 0.82 which is above 0.05 ($p>0.05$). This implies there is no significant relationship in the mean response of staff on the electrical energy efficiency appliances and devices used in General Hospitals in Kogi State. Therefore, the null hypothesis was accepted, it means that there is no difference in the enlectrical energy efficiency appliances and devices used in the general hospitals. Generally the findings of the study on hypothesis one were in line with the findings of Matsushima *et al*., (2010) where it was found out that there was no significance in the mean response of staff on appliances and devices used in hospitals.

Table 4.2 presents the answers to research question two. The findings on the maintenance practices adopted for electrical energy saving approaches in general hospitals in Kogi State revealed that the maintenance practices are not regularly carried out in the general hospitals. It was found out from the study that Lubricating of fans for efficiency, Cleaning of luminaries, regular cleaning of fans and improving lighting control among others with mean rating ranging from 1.16 to 1.48 are not adopted maintenance practices. While Changing of light bulbs to LED, cleaning or replacing of air filters of the AC in the hospital, X-ray machines, filmprocessors and other machines are switched off when not required, proper positioning of refrigerator and corrective maintenance with mean rating ranging from 3.06 to 3.22 are the highly adopted maintenance practices adopted in General Hospitals in Kogi State. This finding is in support to Alzaben (2015), who reported that any healthcare organization needs a maintenance programme in order to manage all facilities and also needs to carry out maintenance at regular intervals to ensure the safety of users and patients and to make sure that the building is operating within specifications. Also in line with Adenuga (2012), studied the practices of maintenance management in public hospital buildings, and identified the necessary skills for an effective maintenance manager in a hospital. The researcher found that there was a weakness in the maintenance department and the staff is inexperienced, the users of these hospitals were not trained on effective use of hospital facilities.

The null hypothesis was tested at 0.05 level of significant using ANOVA statistics as seen in Table 4.7. The findings revealed that the p-values [Significant (2-tailed)] 0.54 which is above 0.05 ($p>0.05$). This implies there is no significant relationship in the mean response of staff on the maintenance practices adopted for efficient electrical energy saving. Therefore, the null hypothesis was accepted. Generally the findings of the study on hypothesis two were in line with the findings of Ali *et al.,* (2010) where it was found out that there was no significance difference in the mean response of occupants of residential buildings on maintenance practices adopted for efficient electrical energy saving.

The findings of the study on research question three as shown in Table 4.3 revealed the attitudes of hospital staff towards electrical energy savings in general hospitals in Kogi State. From the outcome of the results it was disclosed that the attitudes of the staff towards energy efficiency is good, this attitudes includes closing doors and windows when Ac is put on which was strongly agreed with a mean rating of 3.56 and taking electrical energy saving practices very important, not leaving machines and equipment plugged in overnight when not needed among others were agreed with mean rating ranging from 2.86 to 3.30. While a few items like use of natural sunlight during the day than put on the electric light, turning off the electric oven a few minutes before cooking time runs out and All staff are zealous about electrical energy savings were disagreed from the findings with mean rating ranging from 1.86 to 2.41. This is in contrast with the findings of Nisiforouss *et al.*, (2012), assessed the behavior, attitude and opinion on large enterprise employees with regards to their energy usage habits. The findings of their study revealed that majority of the employees acknowledge that there is waste of energy, which indicated a poor attitude on energy saving. The findings also contradict that of Saba *et al.*, (2016), carried out a research on Behavioural Approaches to Electrical Energy Management in Residential Buildings in Niger State, Nigeria. Their findings showed that, consumers in Niger state rarely adopted the following human behavioural practices; utilization of low wattage lamp to provide required light, usage of appropriate colour for walls and ceilings for better illuminations, switching off light when not in used and they also practiced electrical load management habits at very high extent among others.

The null hypothesis was tested at 0.05 level of significant using ANOVA statistics as seen in Table 4.8. The findings revealed that the p-values [Signifance (2-tailed)] 0.73 which is above 0.05 ($p>0.05$). This indicates that there was no statistical significant difference in the mean responses of Kabba, Lokoja and Okene staff on the attitudes of hospital staff towards electrical energy savings in General Hospitals in Kogi State. Hence, the null hypothesis was accepted. Generally the findings of the study on hypothesis three were in line with the findings of Oyedepo, (2018) as regards to attitudes towards electrical energy saving as there was no significance difference in the mean responses of the respondents. The findings of Saba *et al*., (2016) gave credence to the findings of this on hypothesis three as regards attitudes towards electrical energy savings.

The findings of the study on research question four, on how recent electrical energy appliances and devices are refurbished in general hospitals in Kogi State as unveiled in Table 4.4. The results showed that power strip, Smart energy meters, Smart outlets, LED bulbs, smart thermostats, surgical lights, fans, refrigerators, dry heat sterilizer among others are more recently refurbished with mean rating ranging from 3.53 to 4.00 while Smart thermostats, Home energy monitor, Oven and cloth washers, Anaesthesia machines, Electrocardiogram EKG machines among others are recently refurbished with mean ratings ranging from 3.11 to 3.39. The findings is in agreement with Zubair *et al*., (2016), assessed the safety and preventive maintenance of biomedical devices in Nigerian hospitals: a portable low cost electrical safety analyzer. The findings unveiled adequate level of refurbishment in the electrical medical device. Similarly, in conformity with findings of Firdaus *et al*., (2019) revealed that the maintenance for energy efficiency: a review. In their study various literatures and publication on the research areas were reviewed and summarized to show the significance of refurbishment and approached commonly used for electrical energy saving and efficiency.

Consequently, the null hypothesis was tested at 0.05 level of significant using ANOVA statistics as seen in Table 4.9. The findings revealed that the p-values [Sigficance (2-tailed)] 0.069 which is above 0.05 ($p>0.05$). The implication of this is that there was no statistical significant difference in the mean responses of Kabba, Lokoja and Okene technicians on the electrical energy appliances and devices refurbished in General Hospitals in Kogi State. Thus, the null hypothesis was accepted. The findings of the study on hypothesis four were in line with the findings of Fennigkoh and Smith (2012) where it was found out that there was no significance difference in the mean ratings of the responses of staff on electrical energy appliances and devices refurbished. The findings of Taghipour *et al*., (2012) gave credence to the findings of this study on hypothesis four as regards refurbishing appliances and devices in General Hospitals in Kogi State.

Finally, from Table 4.5 is the findings of the study on research question five on how staff are motivated towards electrical energy savings in general hospitals in Kogi State shows that there is poor staff motivation towards energy savings. From the findings on this research question, Use of posters, labels stickers and banners, Incentives for staff actively carrying out electrical energy saving measures, Organizing online classes for staff on electrical energy saving among others was strongly disagreed with mean ratings ranging from 1.23 to 1.45. This is conformity with the findings João and Justina (2016) assessed the motivating towards energy efficiency in small and medium enterprises. Their finding revealed poor motivation by employers. They recommended the need for staff motivation on energy saving. The findings is also in conformity with that of Caroline *et al*., (2017), investigated energy saving in the workplace: why, and for whom?. The outcome showed a weaker intention to save energy. Hence, the need for promoting motivations, particularly those that focus on benefits to the organization, may be an effective addition to environmental messages typically used as motivations in campaigns.

The null hypothesis was tested at 0.05 level of significant using ANOVA statistics as seen in Table 4.10. The findings revealed that the p-values [Significance (2-tailed)] 0.00 which is below 0.05 ($p>0.05$). The implication of this is that there was statistical significant difference in the mean responses of Kabba, Lokoja and Okene staff on ways they are motivated towards electrical energy savings in General Hospitals in Kogi State. Thus, the null hypothesis was rejected. Generally the findings of the study on hypothesis five were in contrast with the findings of Wells *et al*., (2016) where it was found out that there was no significance difference in the mean responses of staff on the motivations towards electrical energy savings. The findings of Caroline *et al*., (2017) gave credence to the findings of this study on hypothesis five as regards staff motivation towards electrical energy savings.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Power generation and energy consumption has become a major concern in African countries especially Nigeria. As a result of inadequate generation of power, management and utilization of the available energy is paramount. As a concern, the perspectives of the adoption of innovative technologies and techniques in buildings, it has to be noted that the most common problems are the lack of information and knowledge, and the lack of economic incentives. Therefore, notwithstanding the complex situation, the strict regulations and the 24 hours per day operability, this study clearly demonstrate that the potential for energy savings in hospitals is very high, estimated to range from 20 to 50 per cent. Those savings in terms of energy consumption can be reached by hospital organizations through two different and complementary ways: installation of Electrical energy efficiency appliances and devices adopting appropriate maintenance practices,

Positive attitude of hospital staff towards electrical energy saving, poor maintenance practices and staff motivation towards electrical energy savings, and refurbishment of building areas, appliances and devices can be performed by adopting most advanced and efficient technical solutions (new materials, building services and more efficient technical components). The hospital building users (patients, medical and nurse staff, administrative staff) can be made aware of electrical energy inefficiencies and trained for a more efficient use of electrical energy resources.

5.2 Recommendations

Based on the findings of this study, the following recommendations are made:

1. The hospital management board should ensure the installation of energy saving appliances in the hospital. This can be achieved through partnership with green energy companies to manufacture, supply, install and maintain their appliances.
2. Maintenance practices should be improved by the hospital management by organizing seminars and workshop for staff on maintenance practices. This will help educate the staff on proper maintenance of appliances and devices.
3. The attitude of staff should be improved towards energy savings through training, seminar and workshop on the importance of energy savings in an organization.
4. The attitude of staff should be improved through promotional of energy savings activities such as wall stickers, labels charts and illustration to constantly remind staff and other users of energy about energy savings.
5. The government should ensure to replace or refurbish worn out appliances and devices in the hospital to save and manage efficient electrical energy.
6. Staff should be motivated towards electrical energy savings through special allowances to the best energy saving staff. Free sponsored trips and other incentives can also be used to motivate staff.

5.3 Suggestion for Further Study

The following are suggested for the study:

1. Study on analysis of electrical energy saving approaches adopted in general hospitals should be conducted in other states of the Federation and FCT in order to generalize the findings.
2. Similar study should be conducted in other industries that utilizes good amount of power supply.

3. Analysis of electrical energy saving approaches adopted in residential buildings in Kogi State, Nigeria.

5.4 Contribution to Knowledge

The study exposed the level at which electrical appliances were put into use in General Hospitals in Kogi State, with mean value of 2.26 which indicated that electrical energy efficiency appliances were rarely used for electrical energy saving. The mean point of 1.37 revealed that staff were not motivated towards adequate electrical energy savings in General Hospitals in Kogi State.

REFERENCES

Abrahamse, W., & Steg, L. (2000). Factors related to household energy use and intention to reduce it: The role of psychological and socio-demographic variables. *Human ecology review,* 30-40.

Ademiluyi, I. A., & Aluko-Arowolo, S. O. (2019). Infrastructural distribution of healthcare services in Nigeria: an overview. *Journal of geography and regional planning*, 2(5), 104-110.

Adenuga, O. A. (2012). Maintenance management practices in public hospital built environment: Nigeria case study. *Journal of Sustainable Development in Africa*, 14(1), 185-201.

Ajzen, I., & Fishbein, M. (1980). A Bayesian analysis of attribution processes. Psychological bulletin, 82(2), 261.

Albert, M., Makashini, L., Abanda H., N'gombie A., & Mudenda, P. (2015). "A comparative analysis of energy usage and energy efficiency behavior in low- and high income households: The case of Kitwe, Zimbabwe." Resources, 4(4), 871-902.

Ali, A. (2012). Electrical Energy Efficiency Improvement In Commercial Buildings (Doctoral dissertation). Published thesis of Building, Ahmadu Bello University Zaria, Nigeria

Ali, I., Rehman, K. U., Ali, S. I., Yousaf, J., & Zia, M. (2020). Corporate social responsibility influences, employee commitment and organizational performance. *African Journal of Business Management*, 4(13), 2796-2801.

Almaiyah, S. & Short, C. A. (2019). Sustainability and low-energy hospital design in Great Britain. In The Nordic Conference about Future Hospital Buildings–milliards of investment and as much care for the money as possible.

Alumona, T. L., Nwosu, M. O., Ezechukwu, A. O., & Chijioke, J. (2014). Overview of losses and solutions in power Transmission lines. *Network and Complex System,* 4(8), 24-31.

Alzaben, H. (2015). Development of a maintenance management framework to facilitate the delivery of healthcare provisions in the Kingdom of Saudia Arabia (Doctoral dissertation, Nottingham Trent University).

Baatz, B. & Barrett, J. (2018). Estimating the Value of Energy Efficiency to Reduce Wholesale Energy Price Volatility. ACEEE Report U1803.

Badru, F. A. (2018). Sociology of health and illness relations in Olurode. *Sociology for Beginners*. John West Ikeja, 336-355.

Baily, M. N., Farrell, D., & Remes, J. (2016). McKinsey Global Institute,'. *Where US productivity is growing', McKinsey Quarterly,* (2).

Bakaimis, B., & Papanikolaou, I. (2017). Electrical energy saving policies, initiatives, results, challenges and lessons learned for the Grevena hospital. Procedia environmental sciences, 38, 882-889.

Beamon, K., & Messer, C. M. (2018). The Enduring Color Line in US Athletics. Routledge.Availableonline:http://www.taylorfrancis.com/books/mono/10.4324/9781315879611/endurng-color-line-athletics (accessed on 17 March 2021).

Benkova, N. (2017). The Reality of Governmental Subsidies to the Nuclear Industry. How Far from the Ideal? (*Doctoral dissertation*, Masarykova univerzita, Fakulta sociálních studií).

Bin, S. (2012). Greening work styles: an analysis of energy behavior programs. *American Council for an Energy Efficient Economy*. Washington, DC.

Bizzarri, G., & Morini, G. L. (2006). New technologies for an effective energy retrofit of hospitals. *Applied Thermal Engineering*, 26(2-3), 161-169.

Britannica, T. (2020). Editors of Encyclopedia. Kogi Encyclopedia Britannica. Retrieved from http://www.britannica.com/place/Kogi. (accessed on 13/08/2020).

CADDET renewable energy (2011). Solar Pumping in India. Proceedings of the 3rd International Conference on Civil Engineering for Sustainable Development. Bangladesh ISBN: 978-984-34-0265-3.

Caroline, L., Eamonn, & F. Alexa, S. (2017). Saving energy in the workplace: Why, and for whom? *Journal of Environmental Psychology*, (pp 50-62).

Carvalho, M., Serra, L. M., & Lozano, M. A. (2011). Optimal synthesis of trigeneration systems subject to environmental constraints. *Energy*, 36(6), 3779-3790.

Chirarattananon, S., Chaiwiwatworakul, P., Hien, V. D., Rakkwamsuk, P., & Kubaha, K. (2010). Assessment of energy savings from the revised building energy code of Thailand. *Energy*, 35(4), 1741-1753.

Christiansen, F., Rojano-Doñate, L., Madsen, P. T., & Bejder, L. (2016). Noise levels of multi-rotor unmanned aerial vehicles with implications for potential underwater impacts on marine mammals. Frontiers in Marine Science, 3, 277.

Chung, M., & Park, H. C. (2015). Comparison of building energy demand for hotels, hospitals, and offices in Korea. *Energy*, *92*, 383-393.

Dascalaki, E. G., Gaglia, A. G., Balaras, C. A., & Lagoudi, A. (2019). Indoor environmental quality in Hellenic hospital operating rooms. *Energy and Buildings*, 41(5), 551-560.

Diakaki, C., Grigoroudis, E., & Kolokotsa, D. (2017). Towards a multi-objective optimization approach for improving energy efficiency in buildings. *Energy and buildings*, 40(9), 1747-1754.

Diesendorf, M. (2019). Energy futures for Australia. In Decarbonising the Built Environment (pp. 35-51). Palgrave Macmillan, Singapore.

Elliot, M. A., & Ainsworth, K. (2012). Predicting University undergraduates' binge-drinking behavior: A comparative test of the one- and two-component theoriesof planned behavior. Addictive Behaviors 37.1: 92-101.

Enshassi, A., El Shorafa, F., & Alkilani, S. (2015). Assessment of operational maintenance in public hospitals buildings in the Gaza Strip. *International Journal of Sustainable Construction Engineering and Technology*, 6(1), 29-43.

Eusoff, M. F., & Ismail, M. R. (2015). Potential of building automation system towards efficient energy management of healthcare buildings. *International Journal of Energy Technology and Policy*, 11(2), 142-164.

Fakhrudin, I. H., Suleiman, M. Z., & Talib, R. (2011). The need to implement Malaysia's Building and Common Property Act 2007 (Act 663) in building maintenance management. *Journal of Facilities Management*, 3(2) 14-27.

Faremi, O. J., & Adenuga, O. A. (2012). Evaluation of maintenance management practice in banking industry in Lagos state, Nigeria. *International Journal of Sustainable Construction Engineering and Technology*, 3(1) 218-224.

Fennigkoh, L. & Smith, B., 2012, "Clinical equipment management", J*CAHO PTSM Series*, 2(1) 5-14.

Fifield, L. J., Lomas, K. J., Giridharan, R., & Allinson, D. (2018). Hospital wards and modular construction: Summertime overheating and energy efficiency. *Building and Environment*, 141, 28-44.

Firdaus, N., Samat, H. A. & Mohamad, N. (2019). Maintenance for Energy efficiency: A Review. IOP Conf. Series: Materials Science and Engineering. (pp. 548 - 553). Universiti Sains Malaysia, Malaysia.

Fishbein, M. & Ajzen, I. (1975). Predicting and understanding family planning behaviors. In Understanding attitudes and predicting social behavior. Prentice Hall.

Forkel, M., Dorigo, W., Lasslop, G., Teubner, I., Chuvieco, E., & Thonicke, K. (2017). A data-driven approach to identify controls on global fire activity from satellite and climate observations (SOFIA V1). *Geoscientific Model Development*, *10*(12), 4443-4476.

Franco, A., Shaker, M., Kalubi, D., & Hostettler, S. (2017). A review of sustainable energy access and technologies for healthcare facilities in the Global South. *Sustainable Energy Technologies and Assessments*, 22(3) 92-105.

García-Sanz-Calcedo, J. (2014). Analysis on energy efficiency in healthcare buildings. *Journal of Healthcare Engineering*, 5(3), 361-374.

Gkouskos, Z., Limnaios, G., Tsoutsos, T., & Cabeza Fabra, L. F. (2010). Study of energy saving in a Greek building using Phase Change Materials. In EUROSUN 2010, International Conference on Solar Heating, Cooling and Buildings (Vol. 28, pp. 09-1).

González, A., Norambuena-Contreras, J., Storey, L., & Schlangen, E. (2018). Self-healing properties of recycled asphalt mixtures containing metal waste: An approach through microwave radiation heating. *Journal of environmental management*, 21(4) 242-251.

Gordo, E. (2017). Energy Efficiency in a Hospital Building Case Study: Hospitnis da Uviversidade de Coimbral, Portugal. Energetics IYCE 2011. In: the Proceedings of the 2011 3rd International Youth Conference on Energetics, (pp 1-6) Retrieved from: http://www.ieeexplore.ieee.org

Hagger, M. S. (2019).The reasoned action approach and the theories of reasoned action and planned behavior. In D. S. Dunn (Ed.), Oxford Bibliographies in Psychology. New York, NY: Oxford Universities Press. doi: 10.1093/OBO/9780199828340-0240.

Hammad, A. A. (2018). A comparative study of energy consumption between various hospitals in Malaysia/Hammad Ahmad Ainuddin (Doctoral dissertation, University of Malaya). Retrieved from: http://www.ieeexplore.ieee.org

Horner, N., & Azevedo, I. (2016). Power usage effectiveness in data centers: overloaded and underachieving. *The Electricity Journal*, *29*(4), 61-69.

Husaini, A. A., & Tabassi, A. A. (2014). Performance assessment of maintenance practices in government office buildings: case study of parcel e, Putrajaya. In MATEC Web of Conferences (Vol. 10, p. 03002). EDP Sciences.

International Energy Agency. (2014). *Capturing the multiple benefits of energy efficiency*. OECD.

Jamshidi, A., Rahimi, S. A., Ait-kadi, D., & Bartolome, A. R. (2010). Medical devices inspection and maintenance; a literature review. In IIE annual conference. Proceedings (p. 3895). Institute of Industrial and Systems Engineers (IISE).

Jandali, D., Sweis, R. J. & Alawneh, A. R. (2017). Factors Affecting Maintenance of Hospital Buildings: A Literature Review. *International Journal of Information, Business and Management*, *10*(3), 69-83.

João H. & Justina, C. (2016). Motivating towards energy efficiency in small and medium enterprises. *Journal of Cleaner Production*, 139, 42-50.

Joint Commission on Accreditation of Healthcare Organizations JCAHO (2006). Health System. 67-70.

Kamchuchat, C. (2013) "Energy Conservation in Vachira Phuket Hospital," *Vachira Phuket Hospital.*, 11(2), 749–757.

Karekezi, R. (2017). Sharps injuries among healthcare workers and waste handlers at a public teaching hospital in Kigali Rwanda (Doctoral dissertation).

Karkanias, C., Boemi, S. N., Papadopoulos, A. M., Tsoutsos, T. D. & Karagiannidis, A. (2018). Energy efficiency in the Hellenic building sector: An assessment of the restrictions and perspectives of the market. *Energy Policy,* 38(6), 2776-2784.

Kennan, J. M. (2019). Climate adaptation finance and investment in California *International Jounal on Climatic Change* 1(5) 72-79.

Khan, I. & Halder, P. K. (2016). Electrical Energy Conservation through human behavior change: perspective in Bangladesh. *International Journal of Renewable Energy Research*, 6(1), 1306-1315.

Kolokotsa, D., Pouliezos, A., Stavrakakis, G., & Lazos, C. (2019). Predictive control techniques for energy and indoor environmental quality management in buildings. *Building and Environment*, 44(9), 1850-1863.

Kolokotsa, D., Sutherland, G., Stavrakakis, G., Karatassou, S.,& Santamouris, M. (2017). A matrix tool for assessing the performance of intelligent buildings. Management of Environmental Quality: *An International Journal of Envirromental Management* 3(1), 95-112.

Kolokotsa, D., Tsoutsos, T., & Papantoniou, S. (2012). Energy conservation techniques for hospital buildings. *Advances in Building Energy Research*, 6(1), 159-172.

Ling, Y., Shu, G., Wenchang, L., & Lin, H. U. (2020). Rural Household Energy Consumption Investigation and Structural Pattern Analysis of Xuanwei study area in Central Yunnan. In IOP Conference Series: Earth and Environmental Science (565) 1, 012017. IOP Publishing.

Lovin's, F. A. (2018). Sociology of health and illness relations in Olurode. *Sociology for Beginners*. John West Ikeja, 336-355.

Matsushima, K., Nishimura, T., Ichikawa, S., Sekiguchi, M., Tanaka, T., Hakata, A., & Tazuke, F. (2010). Indoor lighting facilities. *Journal of Light & Visual Environment*, *34*(3), 195-210.

Maytham, A. S., Mohammed, A., Khatib, T., Shareef, H., Homod, R.Z., & Abd Ali, J. (2017). Real time optimal schedule controller for home energy management system using new binary backtracking search algorithm. *Energy and Buildings*, 13(8) 215-227.

Ministry of Health Kogi State (2021). Population of health workers in Kogi State. Retrieved on 18 of January 2021.

Mirdeeliana, A. (2012). Customers satisfaction towards maintenance management in a government hospital building in Malaysia. In Proc., 1st Int. Conf. on Innovation and Technology for Sustainable Built Environment (pp. 403-411).

Mkalaf, K. A. (2018). A study of current maintenance strategies and the reliability of critical medical equipment in hospitals in relation to patient outcomes, *Doctor of philosophy thesis*, Faculty of Engineering and Information Sciences, University of Wollongong. Retrieved from https://ro.uwo.edu.au/thesis 4676 (accessed on 10 of January 2021).

Moghimi, M. A., Craig, K. J.,& Meyer, J. P. (2015). A novel computational approach to combine the optical and thermal modelling of Linear Fresnel Collectors using the finite volume method. *Solar Energy*, 116, 407-427.

Moghimi, M. A., Craig, K. J., & Meyer, J. P. (2015). Optimization of a trapezoidal cavity absorber for the Linear Fresnel Reflector. *Solar Energy*, 119, 343-361.

Mohd-Ali, S. B. Hasanuzzaman, M., Rahim N. A., Mamun, M. A. A. & Obaidellah, U. H. (2021). Analysis of energy consumption and potential energy savings of an institutional building in Malaysia. *Alexandria Engineering Journal,* 60(2), 805–820.

Morgenstern, P., Li, M., Raslan, R., Ruyssevelt, P., & Wright, A. (2016). Benchmarking acute hospitals: Composite electricity targets based on departmental consumption intensities?. *Energy and buildings*, 118, 277-290.

Morgenstern, P., Raslan, R., & Huebner, G. (2016). Applicability, potential and limitations of staff-centred energy conservation initiatives in English hospitals. *Energy Efficiency*, 9(1), 27-48.

Nisiforous O., Alexandros, P. & Charalambides, A. (2012). Behaviour, attitudes and opinion of large enterprise employees with regard to their energy usage habits and adoption of energy saving measures *Energy and Buildings*, 55(2), 299–311.

Nworgu, B. G. (2018). Educational Research Basic Issue of Methodology. Ibadan: Wisdom Publisher.

Ogunmakinde, O.E., Akinola, A.A., & Siyanbola, A. B. (2013) 'Analysis of the factors affecting building maintenance in government residential estates in Akure, Ondo State, Nigeria', *Journal of Environmental Sciences and Resources Management,* 5 (2) 89-103

Ojo, A. I., & Popoola, S. O. (2019). Some correlates of electronic health information management system success in Nigerian teaching hospitals. *Biomedical Informatics Insights*, 7, BII-S20229.

Okafor, E. N. C., & Joe-Uzuegbu, C. K. A. (2020). Challenges to development of renewable energy for electric power sector in Nigeria. *International Journal of Academic Research*, *2*(2).

Olayinka, A., & Owolabi, O. (2015). Evaluation of the factors affecting housing maintenance and its probable solutions. *International Journal of Latest Research in Engineering and Technology*, 1(4), 59-64.

Oliveira, A. M., Lopes, I. D. S., & Figueiredo, D. (2014). Maintenance management practices of companies of the industrial pole of Manaus. World Congress on Engineering and Computer Science 2,22-24

Oyedepo, S. O. (2018). Energy efficiency and conservation measures:tools for sustainable energy development in Nigeria. *International Journal of Energy Engineering*, 2(3), 86-98.

Oyeleke, O. O. (2018). Comparative Analysis of Household Energy Consumption in Ibadan Region; A Sapio-quantitative Approach. *Advanced journal of Social Science*, 3(1), 34-46.

Pothitou, M., Hanna, R. F., & Chalvatzis, K. J. (2000). Environmental Knowledge, pro-environmental behaviour and energy savings in households: An empirical study. *Applied Energy*, 184, 1217-1229.

Qahtan, A. M., Ebrahim, D. A., & Ahmed, H. M. (2020). Energy-saving potential of daylighting in the Atria of Colleges in Najran University, Saudi Arabia. *International Journal of Built Environment and Sustainability*, *7*(1), 47-55.

Qian, H., Li, Y., Seto, W. H., Ching, P., Ching, W. H., & Sun, H. Q. (2020). Natural ventilation for reducing airborne infection in hospitals. *Building and Environment*, *45*(3), 559-565.

Rice, J. J., Martino, M. M., De Laporte, L., Tortelli, F., Briquez, P. S., & Hubbell, J. A. (2013). Engineering the regenerative microenvironment with biomaterials. *Advanced healthcare materials*, 2(1), 57

Ridgway M., (2008). “Decoding the PM puzzle”, presented at 20th Biomedical Symposium Massachusetts, *Healthcare Maintenace* 15(4) 320-328

Ridgway, M. (2009). Optimizing our PM programs”, *Bio.Instru. &Tech*., 40(3), 244-254.

Rosen, M. A. (2019). Energy sustainability: *A pragmatic approach and illustrations. Sustainability*, 1(1), 55-80.

Ruan, R., Zhang, Y., Chen, P., Liu, S., Fan, L., Zhou, N., & Li, B. (2019). Biofuels: introduction. In Biofuels: Alternative feedstocks and conversion processes for the production of liquid and gaseous biofuels (pp. 3-43). Academic Press.

Saba, T. M., Tsado, J., Hassan, B., & Owodunni, A. S. (2016). Behavioural Approach to Electrical Energy Management in Residential Buildings for Niger State, Nigeria. *Multidisciplinary Journal of Science, Technology and Vocational Education*, 2(2), 99-109

Saba, T. M., Jacob, T., Bashir, B., & Joseph O. E. (2016). Level of Electrical Energy Management Practice Awareness Among Residents in Niger State, Nigeria. *American Journal of Engineering and Technology Management*, 1(1), 1-6.

Saidur, R. (2010). A review on electrical motors energy use and energy savings. *Renewable and sustainable energy reviews*, 14(3), 877-898.

Saidur, R., & Mekhilef, S. (2010). Energy use, energy savings and emission analysis in the Malaysian rubber producing industries. *Applied Energy*, 87(8), 2746-2758.

Saidur, R., Hasanuzzaman, M., Yogeswaran, S., Mohammed, H. A., & Hossain, M. S. (2010). An end-use energy analysis in a Malaysian public hospital. *Energy*, 35(12), 4780-4785.

Siemens, L. (2019). ‘It's a team if you use “reply all”’: An exploration of research teams in digital humanities environments. *Literary and linguistic computing*, 24(2), 225-233.

Sofronis, I., & Markoyannakis, G. (2016). Energy consumption in public hospitals. In *Symposium Energy Conservation in Hospitals, European Commission, SAVE Programme, Athens.*

Sweis, R. (2015). An investigation of failure in information systems projects: The case of Jordan. *Journal of Management Research*, 7(1), 173-185.

Sweis, R. J., Al-Mansour, A., Tarawneh, M., & Al-Dweik, G. (2013). The impact of total quality management practices on employee empowerment in the healthcare sector in Saudi Arabia: a study of King Khalid Hospital. *International Journal of Productivity and Quality Management*, 12(3), 271-286.

Taghipour S, Banjevic D. & Jardine A.K.S. (2012) Prioritization of Medical Equipment for Maintenance Decisions", *Journal of Operational Research Society*, 62 (9) 1666-1687.

Tan, T., Mills, G., Papadonikolaki, E., & Liu, Z. (2021). Combining multi-criteria decision making (MCDM) methods with building information modelling (BIM): A review. *Automation in Construction*, 12(10) 34-45.

Tan, Y. (2014). Transparency without Democracy: The Unexpected Effects of China's Environmental Disclosure Policy. *Governance*, *27*(1), 37-62.

Taneja, S., & Toombs, L. (2014). Putting a face on small businesses: Visibility, viability, and sustainability the impact of social media on small business marketing. *Academy of marketing studies journal*, 18(1), 249.

Testa, F., Cosic, A., & Iraldo, F. (2016). Determining factors of curtailment and purchasing energy related behaviours. *Journal of cleaner production*, 112,(2) 3810-3819.

Thinate, N., Wongsapai, W., & Damrongsak, D. (2017). Energy performance study in Thailand hospital building. *Energy Procedia*, 141(4) 255-259.

Treble, J. (2017). "Why behaviour change matters," The Green Consultancy, [Online]. Available: https://www.greenconsultancy.com/discover-total-energy management/implementing-energy-efficiency-opportunities/energy-training-and-behaviour-change.

Tsoutsos, T., Aloumpi, E., Gkouskos, Z., & Karagiorgas, M. (2010). Design of a solar absorption cooling system in a Greek hospital. *Energy and Buildings*, 42(2), 265-272.

Van Heur, R., & Verheijen, M. (2018). Power Quality Utilization Guide. Leonardo Energy. Report to European Copper Institute.

Vanhoudt, D., Desmedt, J., Van Bael, J., Robeyn, N., & Hoes, H. (2017). An aquifer thermal storage system in a Belgian hospital: Long-term experimental evaluation of energy and cost savings. *Energy and Buildings*, 43(12), 3657-3665.

Wang, B. (2017). A medical device collective risk management model for health care organizations and post market oversight. *Journal of Clinical Engineering*, 42(1), 28-35.

Wang, B., & Rice, W. P. (2003). JCAHO's equipment inclusion criteria revisited—Application of statistical sampling technique. *Journal of Clinical Engineering*, 28(1), 37-48.

Weinsziehr, T., & Skumatz, L. (2016, June). Evidence for Multiple Benefits or NEBs: Review on Progress and Gaps from the IEA Data and Measurement Subcommittee. In Proceedings of the International Energy Policy & Programme Evaluation Conference, Amsterdam, The Netherlands.

Wells, V. K., Taheri, B., Gregory-Smith, D., & Manika, D. (2016). The role of generativity and attitudes on employees home and workplace water and energy saving behaviours. *Tourism Management*, 5(6), 63-74.

World Health Organization, WHO (2010). World Health Organization Guidelines for energy consumption in hospitals. Retrieved from: http://www.who.int/inf-fs/fact132.html 30/03/2020.

Yazdanpanah, M., Komendantova, N., & Ardestani, R. S. (2015). Governance of energy transition in Iran: Investigating public acceptance and willingness to use renewable energy sources through socio-psychological model. *Renewable and Sustainable Energy Reviews*, 45(17), 565-573.

Zehner, O. (2019). Green illusions: the dirty secrets of clean energy and the future of environmentalism. University of Nebraska Press. Retrieved from http://books.google.com 2/03/2021

Zubair, A. R., Odelanu, O. J., Ibe, O. M., & Coker, A. O. (2016). Safety and Preventive Maintenance of Biomedical Devices in Nigerian Hospitals: A Portable Low Cost Electrical Safety Analyzer. *Mathematical Analysis and Modelling of Electrical/Electronic Engineering Systems*, 4(3), 235 – 247.

APPENDIX A
INSTRUMENT FOR DATA COLLECTION
FEDERAL UNIVERSITY OF TECHNOLOGY MINNA,
DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION. (ITE)
QUESTIONNAIRE ON ANALYSIS OF ELECTRICAL ENERGY SAVING APPROACHES ADOPTED IN GENERAL HOSPITALS IN KOGI STATE.

SECTION A

INSTRUCTION: Please complete this questionnaire as faithfully as possible and sincerely tick [√] the column that best represents your perception about each item. Your response will be used only for the purpose of this research.

PERSONAL DATA:
General Hospital Lokoja [ ]
General Hospital Okene [ ]
General Hospital Kabba [ ]

SECTION B

Question 1
How are the electrical energy efficiency appliances and devices used in general hospitals in Kogi State?
Please indicate your option using Very Highly Used (VHU), Highly Used (HU), Rarely Used (RU), and Not Used (NU) on the electrical energy efficiency appliances/devices used in general hospitals

S/N	ITEMS	VHU	HU	RU	NU
1.	Tier 2 advanced power strip				
2.	Smart energy meters (SMET 2)				
3.	Modern Socket Outlet				
4.	LED bulbs				
5.	Smart thermostats (Google Nest thermostat)				
6.	Leak sensor				
7.	Motion sensor lighting control				
8.	Continous- flow Anaesthetic machines				
9.	Light dimmers				
10.	Lighting thermal control				
11.	Surgical lights				
12.	Dry heat sterilizer				
13.	Portable electric space heater				
14.	Philips clear vue 550 ultrasound				
15.	KUB X-ray machine				
16.	Rechargeable DC fan				
17.	Halogen lamp (~15–20 lm/W)				
18.	Small waste autoclave				
19.	Split air conditioner				

Question 2

What are the maintenances practices adopted for efficient electrical energy saving in general hospitals in Kogi State?

Please indicate your option using Very Highly Adopted (VHA), Highly Adopted (HA), Rarely Adopted (RA), and Not Adopted (NA) on the maintenance practices adopted for efficient electrical energy saving in general hospitals

S/N	ITEMS	VHA	HA	RA	NA
1	Change light bulbs to LED				
2	Air seal cracks, gaps, leaks and add insulator to maintain heating and cooling				
3	Clean or replace air filters of the AC in the hospital				
4	Lubricating of fans for efficiency				
5	Install a programmable thermostat that will automatically adjust temperature according to schedule				
6	Cleaning of luminaries				
7	Avoid placing appliances that give off heat, such as lamps or TVs near a thermostat				
8	Refrigerator temperature is set to the manufacturer's recommendation				
9	X-ray machines, films processors and other machines are switched off when not required				
10	Regular cleaning of fans				
11	Regular Housekeeping				
12	Identification of (potential) energy loss is usually part of an energy audit				
13	Visual inspection during walk-through audit to identify energy wasted in the facility				
14	Lighting energy audit is performed to evaluate the lighting system in a facility				
15	Purchasing high efficiency motor instead of rewinding burnt coil				
16	Improving lighting control				
17	Proper positioning of refrigerator				
18	Regular adoption of visualized tools for monitoring energy consumption				
19	Predictive maintenance in general hospitals				
20	Preventive maintenance in general hospitals				
21	Corrective maintenance in general hospitals				

Question 3

What are the Attitudes of hospital staff towards electrical energy savings in general hospitals in Kogi State?

Please indicate your option using Strongly Agreed (SA), Agreed (A), Disagreed (D), and Strongly Disagreed (SD) on the attitudes of hospital staff towards electrical energy savings in general hospitals

S/N	ITEMS	SA	A	D	SD
1.	I take electrical energy saving practices very important				
2.	Electrical energy efficiency is the major decision making factor for me when buying appliances/devices				
3.	I will rather use the natural sunlight during the day than put on the electric light				
4.	I turn on computers and machines only when they are needed				
5.	I turn off the electric oven a few minutes before cooking time runs out				
6.	Closing the blinds, shades on the sunny side of the rooms to help keep the room temperature cooler and reduce the work of the AC during summer				
7.	During rainy seasons, I open shades to let the sun warm the rooms and reduce the work of the heater during cold season				
8.	I will rather turn off the lights when they are not in use				
9.	I prefer to replace old appliances with more energy efficient ones				
10.	I rather set refrigerator temperature to the manufacturer's recommendation to avoid excessive cooling and wasting of energy				
11.	Electrical energy saving policy of the organization is well understood and strictly adhered to by me				
12.	I do not leave machines and equipments plugged in overnight when not needed				
13.	I close my doors and windows when AC is put on				
14.	All staff are zealous about electrical energy savings				
15.	I see electrical energy saving practices as extra work load				

Question 4

How long are electrical energy appliances and devices refurbished in general hospitals in Kogi State?

Please indicate your option using More Recent, Recent, Less Recent, and Not Recent on the electrical energy appliances or devices refurbished in general hospitals

S/N	ITEMS	MR	R	LR	NR
1	Power strip				
2	Smart energy meters				
3	Smart outlets				
4	LED bulbs				
5	Smart thermostats				
6	Home energy monitor				
7	Oven and cloth washers				
8	Anaesthesia machines				
9	Electrocardiogram EKG machines				
10	Surgical lights				
11	Fans				
12	Refrigerators				
13	Dry heat sterilizer				
14	Electric space heater				
15	Pulse oximeter				
16	Vacuum aspirator				
17	Ultrasound				
18	Centrifuge				
19	X-ray machine				
20	Laboratory incubator				
21	GeneXpert MTB/RIF diagnostic				
22	Electrocardiograph (ECG)				
23	Oxygen concentrator				
24	Split air conditioner				

Question 5

How are staff motivated towards electrical energy savings in general hospitals in Kogi State?

Please indicate your option using Strongly Agreed (SA), Agreed (A), Disagreed (D), and Strongly Disagreed (SD) on the staff motivations towards electrical energy savings in general hospitals

S/N	ITEMS	SA	A	D	SD
1	Use of posters, labels stickers, and banners.				
2	Creating a specific team for electrical energy saving practices.				
3	Designing a periodical electrical energy programme on saving energy.				
4	Use of open access websites on electrical energy saving behavior				
5	Incentives for staff actively carrying out electrical energy saving measures.				
6	Organizing online classes for staff on electrical energy savings.				
7	Friendly competitions among departments with subsequent rewards on electrical energy savings.				
8	Regular education on electrical energy savings.				
9	Regular statistics of electrical energy usage.				
10	Publication of amount paid for electrical energy usage.				
11	Distributing pens and t-shirt to remind employee on electrical energy saving action				

APPENDIX B

VALIDATION CERTIFICATE

This is to certify that the instrument on the research work titled: **Comparative Analysis of Electrical Energy Saving Approaches Adopted in General Hospitals in Kogi State**. Was validated by me:

Name of First Validates': Usman G. A. (PhD)

Institution: FUT Minna

Department: ITE

Signature and Date: [signature] 11/06/021

Name of Second Validates': Dr E Raymond

Institution: FUT Minna

Department: ITE Dept'

Signature and Date: [signature] 15/06/2021

Name of Third Validates': Engr. Dr. Henry Ohize

Institution: Federal University of Technology, Minna

Department: of Electrical & Electronics Engineering

Signature and Date: [signature] 08/06/2021

Name of Research Student: Ahmed Hadi Onimisi

Matriculation Number: MTech/SSTE/2018/8657

Programme of Study: MTech Industrial and Technology Education (Elect/Elect Technology)

APPENDIX C

Scale: Research Question 1

Case Processing Summary

		N	%
Cases	Valid	15	100.0
	Excluded[a]	0	.0
	Total	15	100.0

Reliability Statistics

Cronbach's Alpha	N of Items
.847	19

Scale: Research Question 2

Case Processing Summary

		N	%
Cases	Valid	15	100.0
	Excluded[a]	0	.0
	Total	15	100.0

Reliability Statistics

Cronbach's Alpha	N of Items
.759	21

Scale: Research Question 3

Case Processing Summary

		N	%
Cases	Valid	15	100.0
	Excluded[a]	0	.0
	Total	15	100.0

Cronbach's Alpha	N of Items
.781	15

Scale: Research Question 4

Case Processing Summary

		N	%
Cases	Valid	15	100.0
	Excluded[a]	0	.0
	Total	15	100.0

Reliability Statistics

Cronbach's Alpha	N of Items
.812	21

Scale: Research Question 5

Case Processing Summary

		N	%
Cases	Valid	15	100.0
	Excluded[a]	0	.0
	Total	15	100.0

Reliability Statistics

Cronbach's Alpha	N of Items
.798	11

APPENDIX D

HYPOTHESES ONE

Descriptives

Electrical Energy Efficiency Appliances and devices Used

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
GHL	2	2.2895	.73722	.50000	9.7345	73.2655	1.83	2.44
GHO	4	2.2984	.70778	.53311	35.4385	51.5615	2.03	2.48
GHK	3	2.1842	.65001	.20185	38.4955	48.8378	2.20	2.46
Total	9	6.7721	2.09501	1.23496	40.3278	45.8944	2.02	2.46

Test of Homogeneity of Variances

Electrical Energy Efficiency Appliances and devices Used

Levene Statistic	df1	df2	Sig.
2.199	2	6	.192

ANOVA

Electrical Energy Efficiency Appliances and devices Used

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6.722	2	3.361	.205	.820
Within Groups	98.167	6	16.361		
Total	104.889	8			

HYPOTHESES TWO

Descriptives

Maintenace Practices Adopted

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	Between-Component Variance
						Lower Bound	Upper Bound			
GHL		54	1.8962	.81065	.34944	38.7806	40.1824	34.00	47.00	
GHO		75	1.8714	.74483	.28498	39.2588	40.3945	35.00	45.00	
GHK		62	1.8795	.76163	.41622	38.4742	40.1387	32.00	46.00	
Total		191	5.6471	2.31711	.20092	39.1639	39.9565	32.00	47.00	
Model	Fixed Effects			2.23614	.20132	39.1631	39.9574			
	Random Effects				.20132[a]	38.6940[a]	40.4264[a]			-.04622

Test of Homogeneity of Variances

Maintenace Practices Adopted

Levene Statistic	df1	df2	Sig.
5.350	2	188	.05

ANOVA

Maintenace Practices Adopted

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	9.652	2	4.826	.623	.537
Within Groups	1455.406	188	7.742		
Total	1465.058	190			

HYPOTHESES THREE

Descriptives

Attitudes Of Hospital Staff

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	Between-Component Variance
						Lower Bound	Upper Bound			
GHL		54	2.8500	.53490	.27683	42.3336	43.4441	39.00	48.00	
GHO		75	2.8693	.61428	.27186	42.2050	43.2884	37.00	48.00	
GHK		62	2.8580	.58565	.28391	42.4807	43.6161	38.00	48.00	
Total		191	8.5730	1.3483	.16073	42.5678	43.2019	37.00	48.00	
Model	Fixed Effects			0.5643	.16131	42.5666	43.2030			
	Random Effects				.16131 [a]	42.1907 [a]	43.5789 [a]			-.05429

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Test of Homogeneity of Variances

Attitudes Of Hospital Staff

Levene Statistic	df1	df2	Sig.
.514	2	188	.599

ANOVA

Attitudes Of Hospital Staff

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	3.091	2	1.546	.311	.733
Within Groups	934.375	188	4.970		
Total	937.466	190			

HYPOTHESES FOUR

Descriptives

Electrical Energy Appliances and Devices Refurbished

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum	Between-Component Variance
GHL		2	3.5521	.39686	1.00000	72.2938	97.7062	84.00	86.00	
GHO		4	3.4296	.23199	.85391	84.0325	89.4675	85.00	89.00	
GHK		3	3.5521	.39686	1.00000	78.6973	87.3027	81.00	84.00	
Total		9	14.0451	1.0257	.75359	83.3733	86.8489	81.00	89.00	
Model	Fixd Effects			.37083	.55694	83.7483	86.4739			
	Random Effects				1.20830	79.9122	90.3100			3.21154

Test of Homogeneity of Variances

Levene Statistic	df1	df2	Sig.
.132	2	6	.879

ANOVA

Electrical Energy Appliances and Devices Refurbished

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	24.139	2	12.069	4.323	.069
Within Groups	16.750	6	2.792		
Total	40.889	8			

HYPOTHESES FIVE

Descriptives

Staff Motivations

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum	Between-Component Variance
GHL		54	1.2927	.15434	.17660	15.3495	16.0579	13.00	18.00	
GHO		75	1.3764	.16669	.17116	13.8723	14.5544	11.00	18.00	
GHK		62	1.4282	.11339	.19895	14.7473	15.5430	12.00	18.00	
Total		191	4.0973	.43442	.11444	14.7114	15.1629	11.00	18.00	
Model	Fixed Effects			.01145	.10575	14.7286	15.1458			

Random Effects				.44501	13.0225	16.8519			.55038

Test of Homogeneity of Variances

Staff Motivations

Levene Statistic	df1	df2	Sig.
.837	2	188	.435

ANOVA

Staff Motivations

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	73.707	2	36.853	17.255	.000
Within Groups	401.539	188	2.136		
Total	475.246	190			

RQ1. Mean and standard deviation on electrical energy efficiency appliances and devices used in General Hospitals in Kogi State

S/N	ITEMS	X_1	X_2	X_3	SD_1	SD_2	SD_3	X_t	SD_t	Remark
1.	Tier 2 advanced power strip	2.50	2.50	2.33	0.71	0.58	0.58	2.44	0.62	Rarely Used
2.	Smart energy meters (SMET 2)	2.50	2.25	2.67	0.71	0.50	0.58	2.47	0.60	Rarely Used
3.	Modern Socket Outlet	2.00	2.50	2.33	0.00	0.58	0.58	2.28	0.21	Rarely Used
4.	LED bulbs	3.50	3.50	3.33	0.71	0.58	0.58	3.44	0.62	Highly Used
5.	Smart thermostats (Google Nest thermostat)	2.50	2.00	2.33	0.71	0.00	0.58	2.28	0.43	Rarely Used
6.	Leak sensor	2.00	2.50	2.33	0.00	0.58	0.58	2.28	0.39	Rarely Used
7.	Motion sensor lighting control	1.50	1.75	1.67	0.71	0.50	0.58	1.64	0.60	Rarely Used
8.	Continous-flow Anaesthetic machines	2.00	1.50	1.67	0.00	0.58	0.58	1.72	0.39	Rarely Used
9.	Light dimmers	1.00	1.50	1.67	0.00	0.58	0.58	1.39	0.39	Rarely Used
10.	Lighting thermal control	1.50	1.75	1.67	0.71	0.50	0.58	1.64	0.60	Rarely Used
11.	Surgical lights	3.00	3.50	3.33	0.00	0.58	0.58	3.28	0.39	Highly Used
12.	Dry heat sterilizer	3.00	3.50	3.33	0.00	0.58	0.58	3.28	0.39	Highly Used

13.	Portable electric space heater	1.50	2.00	1.67	0.71	0.00	0.58	1.72	0.43	Rarely Used
14.	Philips clear vue 550 ultrasound	2.00	1.50	1.67	0.00	0.58	0.58	1.72	0.39	Rarely Used
15.	KUB X-ray machine	3.00	3.00	3.33	0.00	0.82	0.58	3.11	0.47	Highly Used
16.	Rechargeable DC fan	2.00	1.50	1.67	0.00	0.58	0.58	1.72	0.39	Rarely Used
17.	Halogen lamp (~15–20 lm/W)	2.00	1.75	1.67	0.00	0.50	0.58	1.81	0.36	Rarely Used
18.	Small waste autoclave	1.50	1.75	1.67	0.71	0.50	0.58	1.64	0.60	Rarely Used
19.	Split air conditioner	2.50	3.25	3.33	0.71	0.50	0.58	3.03	0.60	Highly Used
	GRAND							**2.26**	**0.47**	

RQ2. Mean and standard deviation on the maintenances practices adopted for efficient electrical energy saving in General Hospitals in Kogi State

S/N	ITEMS	X_1	X_2	X_3	SD_1	SD_2	SD_3	$\overline{X}_t$	SD_t	Remark
1	Change light bulbs to LED	3.11	3.15	3.21	0.69	0.67	0.68	3.16	0.68	Highly Adopted
2	Air seal cracks, gaps, leaks and add insulator to maintain heating and cooling	2.35	2.08	2.05	0.48	0.36	0.59	2.16	0.48	Rarely Adopted
3	Clean or replace air filters of the AC in the hospital	3.13	3.48	3.05	0.34	0.50	0.86	3.22	0.57	Highly Adopted
4	Lubricating of fans for efficiency	1.46	1.37	1.53	0.50	0.49	0.54	1.45	0.51	Not Adopted
5	Install a programmable thermostat that will automatically adjust temperature according to schedule	2.11	1.53	1.37	0.63	0.55	0.52	1.67	0.57	Rarely Adopted
6	Cleaning of luminaries	1.52	1.40	1.40	0.54	0.49	0.50	1.44	0.51	Not Adopted
7	Avoid placing appliances that give off heat, such as lamps or TVs near a thermostat	1.61	1.64	1.48	0.63	0.58	0.50	1.58	0.57	Rarely Adopted
8	Refrigerator temperature is set to the manufacturer's recommendation	1.65	1.45	1.68	0.48	0.50	0.51	1.59	0.50	Rarely Adopted
9	X-ray machines, films processors	2.83	3.41	3.00	0.64	0.55	0.79	3.08	0.66	Highly Adopted

	and other machines are switched off when not required									
10	Regular cleaning of fans	1.43	1.68	1.16	0.72	0.64	0.37	1.42	0.58	Not Adopted
11	Regular Housekeeping	1.70	1.67	1.87	0.46	0.48	0.34	1.75	0.43	Rarely Adopted
12	Identification of (potential) energy loss is usually part of an energy audit	1.22	1.16	1.23	0.42	0.37	0.53	1.20	0.44	Not Adopted
13	Visual inspection during walk-through audit to identify energy wasted in the facility	1.07	1.35	1.44	0.26	0.48	0.50	1.29	0.41	Not Adopted
14	Lighting energy audit is performed to evaluate the lighting system in a facility	1.30	1.29	1.27	0.46	0.49	0.45	1.29	0.47	Not Adopted
15	Purchasing high efficiency motor instead of rewinding burnt coil	1.70	1.80	1.69	0.46	0.40	0.47	1.73	0.44	Rarely Adopted
16	Improving lighting control	1.48	1.45	1.50	0.50	0.53	0.50	1.48	0.51	Not Adopted
17	Proper positioning of refrigerator	3.26	2.89	3.03	0.56	0.56	0.54	3.06	0.55	Highly Adopted
18	Regular adoption of visualized tools for monitoring energy consumption	1.17	1.23	1.31	0.38	0.42	0.47	1.24	0.42	Not Adopted
19	Predictive maintenance in general hospitals	1.22	1.31	1.47	0.42	0.49	0.50	1.33	0.47	Not Adopted
20	Preventive maintenance in general hospitals	1.04	1.17	1.27	0.19	0.38	0.45	1.16	0.34	Not Adopted
21	Corrective maintenance in general hospitals	3.11	3.31	3.29	0.63	0.46	0.46	3.24	0.52	Highly Adopted
	GRAND							**1.88**	**0.51**	

RQ3. Mean and standard deviation on attitudes of hospital staff towards electrical energy savings in general hospitals in Kogi State.

S/N	ITEMS	X_1	X_2	X_3	SD_1	SD_2	SD_3	$\overline{X}_t$	SD_t	Remark
1	I take electrical energy saving	3.20	3.07	3.16	0.41	0.50	0.41	3.14	0.44	Agree

	practices very important									
2	Electrical energy efficiency is the major decision making factor for me when buying appliances/devices	2.96	3.08	3.13	0.51	0.40	0.34	3.06	0.42	Agree
3	I will rather use the natural sunlight during the day than put on the electric light	1.85	1.95	1.71	0.74	0.61	0.49	1.84	0.61	Disagree
4	I turn on computers and machines only when they are needed	3.37	3.24	3.29	0.53	0.43	0.64	3.30	0.53	Agree
5	I turn off the electric oven a few minutes before cooking time runs out	1.96	1.92	1.69	0.67	0.75	0.67	1.86	0.70	Disagree
6	Closing the blinds, shades on the sunny side of the rooms to help keep the room temperature cooler and reduce the work of the AC during summer	3.19	3.20	3.19	0.39	0.55	0.44	3.19	0.46	Agree
7	During rainy seasons, I open shades to let the sun warm the rooms and reduce the work of the heater during cold season	3.35	3.12	3.11	0.48	0.49	0.55	3.20	0.51	Agree
8	I will rather turn off the lights when they are not in use	2.13	2.41	2.13	0.67	0.76	0.67	3.23	0.47	Agree
9	I prefer to replace old appliances with more energy efficient ones	3.26	3.16	3.36	0.52	0.57	0.55	3.26	0.55	Agree
10	I rather set refrigerator temperature to the manufacturer's recommendation to avoid excessive cooling and wasting of energy	3.28	3.40	3.44	0.45	0.49	0.50	3.36	0.48	Agree
11	Electrical energy saving policy of the organization is well understood and strictly adhered to by me	2.13	2.23	2.66	0.67	0.63	0.60	2.90	0.53	Agree
12	I do not leave machines and equipment's plugged in overnight when not needed	3.20	3.33	3.32	0.41	0.47	0.47	3.28	0.45	Agree
13	I close my doors and windows when AC is put on	3.59	3.52	3.56	0.50	0.50	0.50	3.56	0.50	Strongly Agree
14	All staff are zealous about electrical energy savings	2.44	2.39	2.40	0.50	0.49	0.50	2.41	0.50	Disagree
15	I see electrical energy saving practices as extra work load	2.96	2.73	2.89	0.19	0.45	0.32	2.86	0.32	Agree
	GRAND							**2.96**	**0.50**	

RQ4. Mean and standard deviation on how long are electrical energy appliances and devices refurbished in general hospitals in Kogi State

S/N	ITEMS	X_1	X_2	X_3	SD_1	SD_2	SD_3	$\overline{X_t}$	SD_t	Remark
1	Power strip	4.00	4.00	3.33	0.00	0.00	0.58	3.78	0.85	More Recent
2	Smart energy meters	4.00	3.75	3.67	.00	0.50	0.58	3.81	0.96	More Recent
3	Smart Socket outlets	4.00	4.00	3.33	0.00	0.00	0.58	3.78	0.97	More Recent
4	LED bulbs	4.00	4.00	3.33	0.00	0.00	0.58	3.78	0.83	More Recent
5	Smart thermostats	4.00	3.50	3.33	0.00	0.58	0.58	3.61	0.39	More Recent
6	Home energy monitor	3.50	3.00	3.67	0.00	0.00	0.58	3.39	0.19	Recent
7	Oven and cloth washers	3.00	3.25	3.33	0.00	0.50	0.58	3.19	0.36	Recent
8	Anaesthesia machines	3.00	3.00	3.33	0.00	0.00	0.58	3.11	0.19	Recent
9	Electrocardiogram EKG machines	3.00	3.00	3.67	0.00	0.00	0.58	3.22	0.19	Recent
10	Surgical lights	4.00	4.00	3.33	0.00	0.00	0.58	3.78	0.19	More Recent
11	Fans	3.50	4.00	3.67	0.71	0.00	0.58	3.72	0.43	More Recent
12	Refrigerators	4.00	3.25	3.33	0.00	0.50	0.58	3.53	0.36	More Recent
13	Dry heat sterilizer	4.00	4.00	3.67	0.00	0.00	0.58	3.89	0.19	More Recent
14	Electric space heater	4.00	4.00	3.33	0.00	0.00	0.58	3.78	0.19	More Recent
15	Pulse oximeter	3.00	3.25	3.00	0.00	0.50	0.00	3.08	0.17	Recent
16	Vacuum aspirator	4.00	4.00	3.33	0.00	0.00	0.58	3.78	0.19	More Recent
17	Ultrasound	3.00	3.25	3.33	0.00	0.50	0.58	3.19	0.36	Recent
18	Centrifuge	3.00	3.25	3.33	0.00	0.50	0.58	3.19	0.36	Recent
19	X-ray machine	3.00	3.25	3.33	0.00	0.50	0.58	3.19	0.19	Recent
20	Laboratory incubator	3.00	3.50	3.33	0.00	0.58	0.58	3.28	0.39	Recent
21	GeneXpert MTB/RIF diagnostic	3.00	3.00	3.67	0.00	0.00	0.58	3.22	0.19	Recent
22	Electrocardiograph (ECG)	3.00	3.50	3.00	0.00	0.58	0.00	3.17	0.19	Recent
23	Oxygen concentrator	4.00	4.00	4.00	0.00	0.00	0.00	4.00	0.00	More Recent
24	Split air conditioner	3.00	3.50	3.67	0.00	0.58	0.58	3.39	0.39	Recent
	GRAND							**3.49**	**0.36**	

RQ5. Mean and standard deviation on ways staff are motivated towards electrical energy savings in general hospitals in Kogi State

S/N	ITEMS	X_1	X_2	X_3	SD	SD_2	SD_3	X_t	SD_t	Remark
1	Use of posters, labels stickers, and banners.	1.48	1.21	1.24	0.54	0.41	0.43	1.31	0.46	Strongly Disagree
2	Creating a specific team for electrical energy saving practices.	1.50	1.35	1.50	0.54	0.48	0.62	1.45	0.55	Strongly Disagree
3	Designing a periodical electrical energy programme on saving energy.	1.41	1.08	1.19	0.53	0.27	0.40	1.23	0.40	Strongly Disagree

4	Use of open access websites on electrical energy saving behavior	1.65	1.28	1.27	0.52	0.45	0.45	1.40	0.47	Strongly Disagree
5	Incentives for staff actively carrying out electrical energy saving measures.	1.41	1.19	1.58	0.50	0.39	0.50	1.39	0.46	Strongly Disagree
6	Organizing online classes for staff on electrical energy savings.	1.33	1.47	1.44	0.48	0.50	0.50	1.41	0.49	Strongly Disagree
7	Friendly competitions among departments with subsequent rewards on electrical energy savings.	1.46	1.05	1.66	0.50	0.23	0.48	1.39	0.40	Strongly Disagree
8	Regular education on electrical energy savings.	1.32	1.27	1.36	0.47	0.45	0.48	1.32	0.47	Strongly Disagree
9	Regular statistics of electrical energy usage.	1.50	1.35	1.11	0.51	0.48	0.32	1.32	0.44	Strongly Disagree
10	Publication of amount paid for electrical energy usage.	1.43	1.44	1.39	0.50	0.50	0.49	1.42	0.50	Strongly Disagree
11	Distributing pens and t-shirt to remind employee on electrical energy saving action	1.22	1.53	1.40	0.42	0.50	0.50	1.38	0.47	Strongly Disagree
	GRAND							**1.37**	**0.47**	

APPENDIX E

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGERIA.

SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION

DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION

Vice Chancellor:
PROF. ABDULLAHI BALA, FSSSN
B. Agric (ABU), M. Sc (Reading), Ph.D (London)

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Website: www.futminna.edu.ng

Your Ref:

Our Ref:

Date: 4th August 2021

To the Chief Medical Doctor
General Hospital Lokoja,
Kogi State

Sir/Ma,

TO WHOM IT MAY CONCERN

The bearer AHMED HADI ONUMISI with Registration Number M.Tech/ 2018/SSTE/8657 is A Master student of Industrial and Technology Education Department.

He is carrying out a research titled: ~~[illegible]~~ ELECTRICAL ENERGY SAVING APPROACHES ADOPTED IN GENERAL HOSPITALS IN KOGI STATE

He needs your assistance to enable him carry out his field work.

We will appreciate your anticipated co-operation.

Thank you.

30/08/2021

Dr. E. Raymond
Postgraduate Coordinator, ITE.

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGERIA.

SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION
DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION

Vice Chancellor:
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Head of Department:
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Website: www.futminna.edu.ng

Your Ref: ______

Our Ref: ______

Date: 1st June 2021

To the Chief Medical Doctor
General Hospital Kabba
Kogi State

Sir/Ma,

TO WHOM IT MAY CONCERN

The bearer AHMED HADI ONUMISI with Registration Number M.Tech/ 2018/SSTE/8657 is A Master student of Industrial and Technology Education Department.

He is carrying out a research titled: ~~ASSESS~~ ELECTRICAL ENERGY SAVING APPROACHES ADOPTED IN GENERAL HOSPITALS IN KOGI STATE

He needs your assistance to enable him carry out his field work.

We will appreciate your anticipated co-operation.

Thank you.

30/08/2021

Dr. E. Raymond
Postgraduate Coordinator, ITE.

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGERIA.

SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION

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FEDERAL UNIVERSITY OF TECHNOLOGY MINNA Technology for Empowerment

Your Ref:

Our Ref:

Date: 7th June 2021

To the Chief Medical Doctor
General Hospital Okene
Kogi State

Sir/Ma,

TO WHOM IT MAY CONCERN

The bearer AHMED HADI OHUMBI with Registration Number M.Tech/ 2018/SSTE/8657 is A Master student of Industrial and Technology Education Department.

He is carrying out a research titled: ~~[illegible]~~ ELECTRICAL ENERGY SAVING APPROACHES ADOPTED IN GENERAL HOSPITALS IN KOGI STATE

He needs your assistance to enable him carry out his field work.

We will appreciate your anticipated co-operation.

Thank you.

30/08/2021

Dr. E. Raymond
Postgraduate Coordinator, ITE.